2

GUIDE TO SPECIAL CONSIDERATIONS IN GOVERNMENT RESEARCH AND DEVELOPMENT CONTRACTING

THESIS

Oscar V. Rodriguez-Morales
Captain, USAF

AFIT/GCM/LSP/89S-9

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

Acknowledgements

I wish to express my sincerest thanks to the personnel with whom I met from Rome Air Development Center, Griffiss AFB NY, and for their input and comments provided in diverse R&D Contracting topics, especially, Col. Robert G. Goering for allowing me to meet with these individuals. Thanks to my advisor, Dr. William C. Pursch, for being so patient and easy going. Special thanks to Mrs. Pursch for reviewing the grammar in this document. I also thank the library staff at AFIT for their help and willingness to assist. I especially wish to thank my wife, Esther, for her patience and help in proof reading and typing parts of the thesis. Last but not least, I wish to thank God for blessing the family with baby Oscar and providing comfort and patience in times of despair.

Oscar V. Rodriguez Morales

AFIT/GCM/LSP/89S-9

GUIDE TO SPECIAL CONSIDERATIONS

IN

GOVERNMENT RESEARCH AND DEVELOPMENT

CONTRACTING

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Contract Management

Oscar V. Rodriguez-Morales, B.S.Ch.E

Captain, USAF

September 1989

Table of Contents

Abstract

This study researched applicable literature on special characteristics related to Government R&D Contracting. Emphasis was placed on small dollar government R&D procurement. A comprehensive literature review, together with informal interviews with contracting personnel from RADC Griffiss AFB NY were used to develop this study. The special characteristics include R&D definitions, different stages in R&D, R&D's interaction with the economy, technical considerations in R&D, R&D contract types, competition and R&D, roles of critical officers in R&D contracting, and some performance problems encountered in R&D. The research for this study showed that R&D is a fundamental component of this nation's technological leadership. Better training is required for personnel involved in R&D procurement. Contracting Officers, Program Managers, and Contract Administrators are part of a very important team which is in charge of supervising the efficiency and effectiveness of government R&D procurement. Most of the performance problems encountered in government R&D procurement can and should be resolved for its success. This study will become part of NCMA's Body of Knowledge library and it condenses the special considerations in government R&D contracting in a manner that is easily accessible to interested readers with some experience in government contracting.

GUIDE TO SPECIAL CONSIDERATIONS IN GOVERNMENT RESEARCH AND DEVELOPMENT CONTRACTING

I. Introduction

The procurement of Research and Development (R&D) programs is one of the most fascinating areas of government contracting. Its objective is to "advance scientific and technical knowledge and apply that knowledge to the extent necessary to achieve agency and national goals" (21:30734). These goals are associated with the development of the necessary tools to maintain the nation's national security and technological leadership (55:52-55).

Research and Development is a complex area of study because of the continuous discoveries and advancements in technology. These discoveries and advancements direct the attention of R&D procurement efforts "towards objectives for which the work or methods cannot be precisely described in advance" (21:30734). This inability to describe the exact work or method to be pursued for R&D efforts has created a wide variety of approaches to this type of procurement. These approaches are a result of the difficulty encountered when trying to specify the desired characteristics of a procurement product when the government only has an idea of what it wants.

In today's R&D environment of "intense competition for decreasing defense resources, technology is more crucial than

ever to maintain our national security" (55:53). Today, defense budgets are getting smaller and system acquisition is becoming more expensive due to advances in technology and the attendant costs associated with them (55:53). These facts tend to indicate that R&D contracting must divert its procurement approach into one of research and cost optimization in which the necessary products are acquired at a reasonable price (55:53).

This study concentrates on the special characteristics of R&D contracting as determined by Dr. Harry Page, National Contract Management Association (NCMA) project consultant. Further, this study is limited to Department of Defense (DOD) government agencies.

The goal of this research is to provide the reader with an opportunity to visualize the way in which R&D contracting is implemented and the steps associated with such type of procurement.

Problem Statement

The information available on R&D contracting is scattered throughout numerous publications and government regulations. The development of an educational training manual for beginner to intermediate level contracting personnel, that could be referenced when dealing with this type of procurement, would make R&D contracting easier to understand.

The area of special considerations in R&D contracting has been identified by the NCMA as one of the components of

the Body of Knowledge required to become a professional in contract management. NCMA's program structure, developed seven years ago (1982) under the guidance of Dr. Harry Page, project consultant, identified the area of special considerations in R&D contracting as one for which a manual should be developed. At this time, no such manual or module is in existence (53).

This study will form the basis for a manual that can be referenced by individuals interested in the area of R&D contracting.

Scope

To develop the "Guide to Special Considerations in Government R&D Contracting" manual into a useful tool for beginner to intermediate level contracting personnel, the following areas of R&D Contracting will be researched:

* Definitions of R&D contracting
* Stages of R&D contracting
* R&D contract types
* R&D and its interaction with the economy
* R&D Statements of Work
* Technical Evaluation Criteria and R&D
* Source Selection and R&D
* Program Manager, Contract Administrator and Contracting Officer's role in R&D
* Performance problems in R&D

The research of these topics will be carried out through an extensive literature review and informal interviews with

contracting personnel from Rome Air Development Center (RADC)/Griffiss AFB NY.

The literature review served as the main focus for the research in this study. The informal interviews contributed to the research of the current strategies and techniques currently employed in this type of procurement.

This study concentrates in the area of government DOD contracting with emphasis on basic research and exploratory development.

Purpose

The objective of this study is to develop a dependable educational training manual for beginner to intermediate level contracting personnel dealing with the topic of government R&D contracting. This manual will become part of NCMA's Body of Knowledge.

It will contain the most current policies, strategies and approaches dealing with government R&D contracting and will be helpful and instructive to interested individuals who lack knowledge in this area.

II. Methodology

Background

The objective of this research is to prepare a "Guide to Special Considerations in Government R&D Contracting" manual to be used by NCMA as part of it's Body of Knowledge for individuals interested in this subject. This manual will provide individuals interested in becoming professionals in contract management knowledge in some specific areas related to R&D Contracting. An extensive literature review supported by informal interviews with personnel from RADC/Griffiss AFB NY was the method of choice for insuring the inclusion of significant material. Even though most of the literature and the informal interviews are related to the Department of Defense (DOD), the concepts and techniques researched are applicable to most other agencies dealing with R&D contracting.

RADC performs R&D type contracting functions ranging from small dollar R&D studies to multimillion dollar advanced systems development efforts. Approximately one half of the contracting actions goes toward basic research and exploratory development.

The process of acquiring new systems for the government is composed of six major phases:

1. Identification, Evaluation, and Validation of the Government need for such a system.
2. Concept Demonstration
3. Demonstration and Validation

4. Full Scale Development; Low rate initial production

5. Production/Deployment

6. Operational Support (17:2-11)

Steps 1-4 are the steps directly related to R&D contracts and are the backbone of R&D procurement (17:2-11). This study consists of a detailed discussion of these steps and the factors associated with them.

Most every product built today has gone through the process of R&D. Research is conducted to determine the Government's need for this product. The Development portion is composed of the buildup and testing of this product. During this stage of development, research continues to be an integral part of the process (17:2-11).

Individuals working in the area of R&D need to be aware of the specific and unique characteristics of this type of procurement. This manual tries to define and describe these characteristics which are unique to R&D.

The first area of research on this study is the introduction to R&D contracting. This area is composed of the basic definition of R&D, and the study of what is meant by R&D research and development.

The second area in this research will deal with the stages in R&D contracting. Any type of acquisition goes through some very definite stages in its conception process. Practically all final products have gone through the stages in R&D contracting. The most common R&D stages are: research, exploratory development, advanced development,

engineering development, and operational systems development (19:3203). A comprehensive explanation of these five stages is found in the contents of this manual. Another stage that could be present in R&D is R&D management and support (24:3403). This stage will also be discussed in this manual.

R&D and its interaction with the economy is another area of study in this manual. The need for good management and support during the early stages of any acquisition is of vital importance for the favorable success of any procurement. R&D is the initial and most important part of any acquisition. Without good initial planning, management, and support, the success of R&D is very limited and unfavorable.

Another area in this study looks at the different types of firms that offer R&D services. This area further examines the role of small Business, and Educational Institutions in the R&D arena. Another topic developed in this area is the impact of Independent Research and Development efforts in R&D procurement. It is of interest to review how different corporations foresee their interests in R&D procurement.

The next area in this study will deal with various technical aspects of the R&D procurement process. A detailed look at R&D Statements of Work and their importance in R&D is reviewed. The Technical Evaluation Criteria used to evaluate firms that offer R&D services is described. The Source Selection Criteria method for R&D is presented. Once these

technical factors are well developed, a discussion of the contract types available for R&D will be performed.

Almost any type of contract is available for R&D procurement. These contract types range from fixed price to cost reimbursement. The difference between one contract type and another is the risk factors incurred by the government and the contractor.

The government's goal of procurement is to acquire most if not all of its products through contract competition. The implications and importance of competition in R&D will be discussed in this manual.

There is a tendency to believe that the roles of the Contracting Officer, Program Manager, and Contract Administrator do not vary for different types of procurement. Some of the basic differences in the roles of these managers in R&D when compared to other types of procurement will be discussed. Once all these factors associated with R&D are developed, some of the performance problems associated with R&D contracting will be discussed.

Common performance problems encountered in R&D and solutions to the same will be examined in this manual. Finally, conclusions and recommendations on ideas that could probably improve the R&D procurement process are presented in the manual.

Procedures

An extensive literature review of books, periodicals, journals, and any other publication available serves as one

of the two basis for this study. The second basis consists of informal interviews conducted with contracting personnel from RADC/Griffiss AFB NY. Bibliographic searches were conducted at various libraries at Wright-Patterson AFB, Ohio. Searches were also conducted through the Defense Logistics Studies Information Exchange and the Defense Technical Information Center.

The following steps are necessary to accomplish the research of data for this study.

1. Examine bibliographic data bases available at diverse libraries at Wright-Patterson AFB to determine the amount of available references.
2. Conduct a comprehensive literature review to be used as one of the basis for this study.
3. Develop an informal agenda to be discussed during the informal interviews at RADC/Griffiss AFB NY. See appendix, for agenda of informal questions to be discussed with contracting personnel from RADC. The information obtained from these informal interviews will become the second basis for this study.
4. Use the literature review and informal interviews as the primary mediums for developing the areas presented in the "Scope" part of this study.
5. Prepare a "Guide to Special Considerations in Government R&D Contracting" manual to be used by

NCMA as part of its Body of Knowledge library of contract management.

Conclusion

Individuals involved in R&D contract type procurement must be aware of the special characteristics associated with this type of acquisition. Presently, there is a great deal of information available on R&D contracting, but it is scattered throughout numerous publications. This manual tries to serve as a guide to special considerations in R&D contracting and present a clear view of that which R&D contracting is composed.

By examining available information, conducting informal interviews in the various areas of R&D, and creating a "Guide to Special Considerations in Government R&D Contracting", a valuable manual is developed for NCMA's Body of Knowledge in contract management. This manual will be helpful to beginner and intermediate level contracting personnel who lack knowledge on this subject. An individual who possesses knowledge in R&D is a very valuable asset in today's defense contracting arena.

This manual will provide interested individuals with the opportunity to learn about R&D contracting and its special characteristics. R&D is the first step in any type of acquisition. The enhancement of a individual's knowledge in R&D contracting is a valuable asset and is the purpose of this research.

III. Literature Review

Research and Development

This section discusses the various definitions that relate to R&D contracting, and is further subdivided into what comprises R&D research in generɛl. Contracting for Research and Development acquisitions is one very important component of the Government's procurement process. R&D contracting comprises the first step of the procurement process for almost any acquisition, commercial or military.

Definitions.

1. Government Contracting Process: function designated to effect the acquisition process (11:1). It provides for a legal interface between the buyer, in this case the government, and the seller, the private contractor.
2. Legal interface: where all the terms in the agreement between the buyer and the seller are reduced to writing and structured according to the laws and government regulations in effect at the time of the agreement (11:1).
3. Contract: resulting document from the legal interface between the buyer and the seller. This document binds the buyer and the seller. (11:1).
4. R&D acquisitions: the Federal Acquisition Regulation (FAR) identifies R&D acquisitions as programs whose main objective is to "advance scientific and

technical knowledge and apply that knowledge to the extent necessary to achieve agency and national goals" (21:18233).

5. Research: tool utilized by the government to provide the "fundamental knowledge required for the solution of military problems" (20:34500). Research in R&D can be subdivided into two broad categories: basic research and applied research.

6. Basic research: basic research is "directed towards increasing knowledge in science" (21:30733). It's objective is to increase the understanding and knowledge of the subject under study, not to develop a practical application of the newly acquired knowledge (21:30733).

7. Applied research: applied research may not be severable from basic research (21:30733). One of its two objectives is to "determine and exploit the potential of scientific discoveries or improvements in technology, materials, processes, methods, devices, or technologies" (21:30733). The other objective of applied research is to try to advance the state of the art (21:30733).

8. State of the art: the state of the art can be defined as "the total capability and ability of a discipline and its supporting systems to accomplish some objective within that discipline at a specified time, past or present" (21:30733).

9. Development function of R&D: can be viewed as "the systematic use of scientific and technical knowledge in the design, development, testing or evaluation of a potential new product (or an improvement to an existing product or service)" (21:30733). Development could be differentiated from research by classifying it as an engineering activity, while research could be classified as a scientific pursuit of knowledge (21:30733). Development in R&D can be subdivided into four distinct categories: exploratory development, advanced development, engineering development, and operational systems development (19:5405; 20:34520; 21:30733). These categories are different stages of the R&D process and will be discussed with more detail in the next section of this manual.

So far in this section, research and development have been treated as separate terms. The combination of these terms represent a continuum in which the sub-categories or stages of research and development mark points along this continuum. The combination of research and development forms the backbone of technology discoveries and improvements. The main difference between research and development is that research efforts are done to advance the state of the art, while a development effort usually confirms this research (20:34520; 21:30733).

R&D Contracting. The vast majority of R&D contracts pursue objectives in which the work or method used to achieve the advancements of scientific and technical knowledge cannot be precisely described or specified in advance. In the process of accomplishing these objectives, R&D contracting tries to encourage qualified sources in the scientific and industrial community to become involved in R&D acquisitions (21:18233). These corporations should provide a working environment which is reasonably flexible and that does not present a high administrative burden (21:18233).

In today's environment, pursuers of R&D programs have to deal with intense competition and decreasing budgets (55:53; 61:7-13). Compounding this problem is the reality that technology is becoming more and more advanced and expensive. However, technology advancements are the backbone of our national security (55:53).

The conflict between intense competition, decreasing budgets, and the costs of technology improvements has created great concern in the government and private industry. It has been indicated that the Department of Defense will have to cut back on R&D spending at least for the next five years (44:1360-1370). The result of this shrinkage in spending indicates that contractors still interested in procuring R&D efforts will have to work harder in order to keep their R&D programs alive (44:1370).

The constant discoveries and advancements in technology make it very difficult for the government to specify a

concrete end item. This fact dictates that R&D contracting requires the use of a very unique strategy. This strategy is approached by varying the acquisition procedures and the diverse contract types used for this type of procurement (11).

R&D procurement has to deal with many socioeconomic goals, contract competition regulations, policies, and limitations on defense budgets making the procurement of these efforts a very challenging area of study and work.

Stages in R&D Contracting

The Department of Defense (DOD) directives 5000.1 and 5000.2 establish the policies, practices, and procedures that "govern the acquisition of major and non-major defense acquisition programs" (18:1). These directives define the DOD acquisition process as a process that is usually composed of six different milestones whose objectives are to enhance management effectiveness. These milestones are accommodated to each particular acquisition with the purpose of minimizing the acquisition time and life cycle costs (18:1-3). Technical risk and urgency of procurement are major factors that influence the milestones of the acquisition process (18:1-3). These milestones are defined below and are to be used in DOD acquisitions when practical (18:3; 46).

a. Milestone O. This milestone marks the "approval or disapproval of a mission need and entry into the concept exploration/definition phase" (18:3; 17:2-4).

b. Milestone I. "Approval or disapproval to proceed into the concept demonstration/validation phase" is granted (18:3).

c. Milestone II. Here permission or denial to enter into the full scale development phase, and low rate initial production is granted (18:4).

d. Milestone III. In this milestone, permission or denial to proceed to full-scale production and initial development is granted (18:4).

e. Milestone IV. This milestone is performed one to two years after initial deployment. Its objective is to verify that operational readiness and support objectives are being "achieved and maintained during the first several years of the operations support phase" (18:4).

f. Milestone V. This milestone consists of the system's review five to ten years after initial deployment (18:4).

Of the above milestones, the first three apply directly to R&D procurement.

Secretary of Defense Cheney's report to the president has proposed the redefinition of Milestone IV. This redefined Milestone IV will replace the current Milestones IV and V, and "will address the need for major upgrades or modifications to systems still in production" (9:19). The final determination on this redefinitions has not been made yet and is under study at the present time.

R&D further divides the activities of interest to defense contracting into five stages and in some exceptional cases into six stages. These stages are: research, exploratory development, advanced development, engineering development, operational system development, and under certain circumstances, management and support.

Research. Research encompasses all scientific study and experimentation effort directed to the increase of knowledge and understanding in fields of physics, engineering, environmental sciences, and life sciences that relate to long-term national security needs (19:5405). This research activity "provides fundamental knowledge that is required for the solution of military problems" (19:5405). Research is the first of the two components of what is known as the R&D technology base. The second component of the R&D technology base is exploratory development. Research in the technology base consists of projects in propulsion, math, advanced materials, bio-tech, and computer science (52:12). Further, research in R&D procurement is subdivided into two broad categories: basic research and applied research.

Basic research is one of the most important activities of R&D. This research is directed towards the increase of knowledge in science (21:30733). Its primary objective is to discover further knowledge or understanding of the subject being studied (21:30733). But, it has to be made clear that basic research does not investigate the practical application of this acquired knowledge (21:30733).

Many analysts of the procurement process categorize basic research as critical to U.S. security (52:12). But ironically, the trend of programs devoted to basic research has declined during the past decade. This decline could be derived from a comment made by Robert T. Marsh, former head of the Air Force Systems Command, "anything in the defense budget that promises results only downstream tends to be given lower priority" (52:12). For example, the funding of basic research programs for 1989 consists of only 2.4 percent of the total budget for Research Development Test and Evaluation (RDT&E) projects (47:19). This trend should be corrected because it is believed that by not investing in research and development, the future of our nation would be mortgaged (47:19). Once the primary study on basic research is conducted, applied research usually follows.

Applied research is the effort that usually follows basic research. This research tries to advance the state of the art (21:30733). Its objective is to determine and develop the probable scientific discoveries or improvements in "technology, materials, processes, methods, devices or techniques" (21:30733). Since this area is basically a continuation of basic research, it suffers all of the problems discussed in the preceding paragraph.

Exploratory Development. A different but related stage of R&D is in the area of exploratory development. Exploratory development is the effort that "is directed toward specific military problems short of major development

problems. Included are studies, investigations and minor development efforts" (19:5405). This type of effort can range from fundamental applied research to sophisticated prototypes, study programming and planning efforts (20:34520). The most dominant part of this type effort is that it is geared towards specific military problem areas (20:34520).

Exploratory development is the second component of the technology base (52:12). It accounts for 6.2 percent of the budgeted RDT&E funds for 1989. The sum of the percentages of funding for basic research and exploratory development only adds up to 8.6 percent of the total RDT&E budget for 1989 (47:19). This small percentage could present a real serious problem in the nation's technology base in the long-run. For example, the percentage for these two categories was 24 percent of the RDT&E budget for 1965 (47:19).

One of the problems associated with budget cuts in the technology base includes the inability of DOD to keep their best researchers (8:1484). The problem associated with this situation is that it creates a second-rate R&D technical work force (8:1484).

Another problem associated with the R&D technology base is poor management (8:1484). A solution for this situation would be to increase the pay for scientists and engineers (8:1484). By applying this solution, many scientists and engineers would be attracted to R&D work.

Secretary Cheney's report has proposed legislation to authorize the Secretary to "design employment, compensation, performance, management, training, and benefit programs to enhance DOD's competitive position in the labor market for acquisition personnel" (9:B-1). The approval of this proposition would undoubtedly fortify the R&D technology base.

If the above steps are implemented, there is a good chance that technology base research would pick up. The next stage in R&D deals with advanced development.

Advanced Development. Advanced development is the effort "directed toward projects which have moved into the development of hardware for tests" (19:5405). The objective of this effort is to verify the design concept, rather than developing hardware for service use (20:34520). The projects under this category possess potential military applications (19:5405; 20:34520). Advanced development accounts for 29.3 percent of RDT&E's 1989 budget (47:19). This amount appears to be reasonable for this type of development, but the Pentagon contends that "many programs funded as advanced development are actually basic research" (52:12). Some analysts of the R&D procurement process contend that some programs are classified as advanced development only "because they are connected to weapon systems" (52:12). Once the programs complete the advanced development phase, the engineering development stage begins.

Engineering Development. Engineering development includes those projects that are still in full-scale development, but have not obtained authorization for production (20:5405). Sometimes this authorization for production has not been approved because the budget for this project was not submitted for the current or subsequent fiscal year (20:34520). This area is characterized "by major live item projects in which program control will be exercised by review of individual projects" (20:34520). The 1989 RDT&E budget for engineering development amounts to 30.4 percent (47:19). This area of R&D accounts for the highest percentage of the budgeted 1989 RDT&E funds, and is characterized by the high costs of new technology. Once the production has been approved, these projects move into the operational system development stage.

Operational System Development. The operational system development stage includes those projects in full-scale engineering development that have been approved for production (21:5405). All the projects in this category are major line item projects (20:34500).

This stage allows for the opportunity to identify operational needs and deficiencies (46:1-5). It initiates the development or improvement of systems or equipment (46:1-5). These operational needs are defined by deficiency or absence of existing systems, the opportunity to use an advancement in technology, or the opportunity to reduce costs (46:1-5). The analysis performed in this stage must examine

the operational mission's task, check the current or projected capability of the system, and make a presentation of the projected threat (46:1-26). The budget for operational system development amounts to 25.1 percent of the total funds budgeted for RDT&E in 1989.

The above stages encompass the most common R&D activities. But, under exceptional circumstances, some management and support effort can also be considered as part of the overall R&D effort.

Management and Support. Management and support activities include efforts that are "directed toward support of installations or operations required for general research and development use" (19:5405). This stage includes "military construction of a general nature unrelated to specific programs, maintenance support of laboratories, operation and maintenance of test ranges, and maintenance of test aircraft and ships" (20:34520). This stage is complicated and delicate. Management has to deal with the present and ever changing desires and ideas of the people in Congress. Depending on the party in control of the legislature, the appropriations and strategies of R&D vary. One reason for this behavior is the huge costs associated with new systems (46:1-26). The R&D effort under this area amounts to 6.7 percent of the budgeted 1989 RDT&E funds (47:12). Even though this stage is not usually directly related to most R&D procurement, it is a hybrid of the same in many circumstances.

The preceding paragraphs include discussions about the most important stages of R&D. All of these are closely related and important in the R&D procurement process.

R&D and its Interaction with the Economy

Research and Development effort in the United States could be classified into four major sectors of the economy: the federal government (including the military), private industry, educational institutions, and a variety of other non-profit institutions (58:29). These sectors of the economy, as they relate to R&D, will be discussed in this section.

As mentioned previously, the main purpose of R&D programs is to maintain the United States scientific and technological superiority in support of military operations (19:5410). This R&D objective has been affected by economic fluctuations throughout its history. Changes in budget strategies and policies have motivated these fluctuations.

By researching the history of industrialized nations, it can be discovered that there exists a link in the economy between R&D, investment in new and more efficient facilities, new products based on technology, and a better standard of living (1:49). One problem in this area is society's focus on short-term rather than long-range objectives. This pattern of thinking affects R&D and diminishes much of the dedication historically pursued by companies in R&D procurement efforts (1:149-150).

One characteristic factor in most industries, government and private, is that the rate at which these agencies have historically funded R&D efforts has started to decline (54:134-138). This decline could affect the nation's technology base. Today companies have started to focus out of long-range R&D, because of the continuous emphasis on short-range profits (43:139-140; 7:17). The most vulnerable of the R&D components is defense-oriented, because of the continuing budget deficits (43:140). Some analysts of the R&D process argue that this trend could be minimized by offering tax credits to firms involved in R&D (22:218). Some analysts attribute the problems in R&D to the new breed of Chief Executive Officer's (CEO's). Most of these CEO's have no engineering or technology background, and consequently do not understand the shifts of technology (43:140).

Another way to minimize the impacts of cuts on defense-oriented research would be to have the R&D industry develop a new look. This new look appears to be on the rise. In a study performed by R&D Magazine it was found that there appears to be a trend of individuals with a higher degree of education entering into the R&D marketplace (34:78-81). This trend has evolved from the desire of individuals to acquire higher educational levels and at the same time, better pay.

Presently, it appears that new talent is entering into the R&D field and older personnel are starting to retire and open the doors to this new talent (34:78-81). This situation

should create a very competent field in the diverse areas of R&D.

Another sector of the economy that affects R&D is the constant changes in policies and regulations by the government. Due to a shrinking defense budget, and reports of contractor overcharges and wrong doings the Congress has opted to change many rules in the defense procurement process. These changes have vanished the notion of guaranteed work at guaranteed profits. In actuality, the process has been replaced by a move to competitive solicitations as directed by the Competition In Contracting Act (CICA) (23; 37:10). Due to these changes, contractors have expressed that not only have these limitations proven to be very costly, but increase the contractor's risk immensely (37:10-12). This pattern affects R&D procurement directly, since the purpose of R&D is to advance technology.

Secretary Cheney's report suggests that existing regulations should be clarified in order to allow DOD "broader discretion in making contract awards competitively based not only on cost but other considerations as well" (9:20). This report also proposes the development of legislation to clarify CICA (9:20).

The above mentioned fluctuations in the economy affect R&D procurement directly. The personnel interviewed at RADC had some definite opinions on how the budget changes affect the R&D acquisition process, what they feel is R&D's role in our society, what are impacts of the latest rules and

policies in R&D, and if government R&D is still a good alternative for private industries to invest in it. The different opinions from the interviewees in each particular subject are discussed below.

In the area of defense budget cuts and how they affect the Government's R&D procurement process various concerns were expressed during the interviews. All of the interviewees agreed that cuts in the budget affect not only the R&D procurement process, but any type of procurement process (10; 26; 33; 36; 38; 42; 45; 50; 56; 57; 59; 62; 66; 67). These cuts have directly affected the R&D process by decreasing the number of new starts in R&D programs (10; 42; 50). The amount of funds usually available for R&D has decreased (10; 57). This decrease has created a problem in which many efforts have to be re-planned, some re-negotiated, and some have to be stretched out for a couple of years (10; 33; 36; 66). Due to the encountered delays, these options affect the technology process in the long-run (10; 66).

Another problem with the defense cuts in R&D is that they produce a lot of work in the affected agencies (10; 36; 62). Some programs have to be delayed in their start affecting the progress of new technology (62). Many programs are being terminated without apparent good reasoning (66).

These budget cuts directly affect the planning process. Many programs that have been initiated and are in the planning phase have to be terminated (66). This situation causes the loss of some very good people that work in R&D and

tend to demoralize many of its participants (38). One good example of poor planning discussed by the interviewees was the Strategic Defense Initiative (SDI) (50). This effort has been plagued with cancellations, re-planning, and stretch-outs (50).

Some of the interviewees believe that cuts in R&D are somewhat foolish, since the superiority in technology depends on R&D efforts now (33). One of the advantages of R&D lies on the speed that these efforts can be conducted and new technology discovered (33). But, since budget decreases create many stretch-outs, the R&D process is directly affected in an adverse manner.

Not all the effects of budget cuts were seen negatively by the interviewees. These cuts tend to create a more selective process on how to spend R&D funds (56; 67). The decrease in defense budgets tend to create more competition among interested contractors (56). These cuts create a better planning process in which R&D efforts have to be prioritized creating the need for sound business decisions (59; 67). Hopefully, these cuts will direct managers to review their planning process and direct them to work together as a team that is working on a common goal of technology superiority and improvement (66).

Another question posed to the interviewees was what is R&D's role in our society. All of the interviewees agreed that R&D is a necessary part of our society and way of living (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 59; 62; 66; 67).

They felt that R&D furthers technology and maintains the United States technological superiority. It is the best way known to improve the state of the art (36; 50; 56; 57).

Another positive aspect of R&D in our society is that it generates a lot of employment in many sectors of the nation's economy (42). R&D fulfills society's need of finding new and better ways of doing things (38). R&D improves the quality of life by discovering new technology and improving older discoveries. All of these factors make pursuing R&D efforts a positive influence in our society. R&D should never lag behind if this nation wants to continue as the leader in technology.

Constant changes in rules and policies in the U.S. tend to affect all the different types of government procurement. R&D efforts tend to be affected because of their uncertain and risky character. The question on how the changes in rules and policies affect the acquisition process was presented to the interviewees. Different opinions were expressed and are summarized below.

Rules and policies in the government are a fact of life. Any type of contracting effort in the government has to deal with the constant change of rules and policies. The constant change of the rules and policies was interpreted by the interviewees as one of the greatest problems. It was expressed that it is difficult to pin down how new rules and policies affect the R&D acquisition process because they are

always changing (38). This constant change tends to confuse people (38).

Another problem with the new rules and policies is that they are implemented by Congress or higher headquarters and many of the creators have no knowledge or experience in the R&D arena (66; 67). This tends to create chaos and confusion within the participants in the R&D process. This chaos and confusion is created by the implementation of these new rules and policies that do not allow for feedback from the participants in the R&D process (62).

Another problem with the new rules and policies is that they create more paperwork and take a lot of time to fulfill all of their requirements (50; 67). One comment made about these new rules and policies is that they become management surrogates and tend to bog down the whole R&D procurement process (67).

Concern was expressed about a few of the new rules and policies recently implemented. Air Force Regulation 70-30 is a regulation being implemented by the government to streamline the R&D acquisition process. The use of this regulation over the historically used Air Force Regulation 70-15 received some mixed comments from the interviewees. One of the interviewees expressed that this Air Force Regulation 70-30 is a primary example of the lack of understanding by higher headquarters of the existence of R&D efforts (67). Another interviewee expressed his concern stating that Air Force Regulation 70-30, even though it was

supposed to streamline the acquisition process, instead its effect has been to create a lot of problems and uncertainties (38). This regulation does not appear to present any advantage over the old Air Force Regulation 70-15 (38). In contrast, some of the interviewees said that Air Force Regulation 70-30 formalizes the streamline process more and this could be viewed as an improvement over Air Force Regulation 70-15.

Another aspect of concern was the proposed streamlining of lead times for R&D efforts. This proposed lead time is composed of a period of 120 days (38; 59). It encompasses the period from the release of the request for proposals (RFP) until the award decision for the effort is made (38; 59). This lead time limits the offeror's time to 30 days for the preparation of a proposal to the government. These 30 days include mail time to and from the contractor (38; 59). Some of the interviewees did not feel that 30 days was enough time to prepare a complete and innovative proposal for R&D acquisitions (38; 59). To one of the interviewees, this urgency of lead times has started to make technicians out of buyers and engineering personnel (59). This activity will end up hurting the R&D process in the long-run.

Another problem with lead time is that it does not allow the buyer to concentrate on the most important efforts (36). It forces the buyers to give the same importance to all the projected efforts (36). One way to remedy this situation would be to create a steady flow of R&D proposals throughout

the fiscal year, instead of issuing all the RFP's at the same time (36).

Other concerns were expressed over socioeconomic programs and certifications that are being implemented into the R&D process. Most of the interviewees expressed that the R&D system is loaded with too many socioeconomic programs (10; 33; 38; 45; 57; 62; 66). These programs seem to hurt the R&D process in the long-run. Examples of such programs are the five percent contract dollar goal for black universities and minority institutions. If an agency does not comply with this goal, it must fully explain and justify failure to reach the goal. This justification process takes time and effort away from the R&D procurement process. One example of the new certifications required is the drug-free work place.

Most of these goals and certifications appear to be justified by the government because of the government's effort to cut down on fraud and criminal activities in the procurement process. The interviews said that most of these activities are necessary in the R&D process, but it takes too much time and effort to comply with all of these. These considerations should be taken into consideration when the lead time for procurement is being trimmed.

The final comments on how R&D and the economy are linked together were geared towards finding out if R&D could still be considered a good alternative for private businesses to continue investing in it.

Most of the interviewees expressed that R&D procurement is not the best contracting area to invest in if the contractor is searching for big profits (10; 25; 45; 57). In contrast, it was expressed that private contractors have to deal in government R&D in order to acquire a taste for the technology that is being pursued and to be able to compete in large development and production programs in the near future.

There is no better way to acquire the experience necessary to compete in the larger programs than by directly participating in R&D efforts (10; 25). By investing in government R&D procurement, private corporations do not have to invest their own money to acquire experience in this subject (10). A private corporation that does not invest in R&D will be out of any kind of competition very soon (38).

R&D is a very good area to invest in, if the contractor is interested in rewarding areas of work. There is always a lot of work and research available to be explored in R&D (56).

As in any other type of government procurement, the private contractor has to analyze the impacts on the corporation of all the government control and paperwork to which the corporation will be subjected (45; 67).

A positive aspect of R&D is that the government contributes to Independent Research and Development (IR&D) efforts by some private corporations. IR&D usually creates good military and commercial applications in benefit of both,

the private industry and the government (33). The subject of IR&D will be discussed separately in this manual.

Types of Firms offering R&D services. The firms that offer R&D services come from all sectors of the nation's economy. They are composed of the traditional large corporations, not-for-profit institutions, federally funded research and development centers, educational institutions, and small businesses. The government has tried to involve as many companies as is reasonably possible in the R&D procurement process (21:30733).

The United States has tried to maintain a policy of technological superiority since the conclusion of World War II (39:5). This policy "has led to an action-reaction mode of development which ultimately leads to many new, complex, and expensive weapon systems" (39:5). This policy has made R&D a major part of the budget appropriated for the Department of Defense.

Some of the R&D funds are expended internally in the Armed Forces laboratories, but most of the funds are used to award contracts to private institutions (39:5). The private industry performs close to two-thirds of all the U.S. R&D effort (39:5).

For the past twenty-five years, the top twenty firms that have performed defense oriented acquisitions have maintained a relatively stable position in their rankings (37:10-16). This situation is due to the problems associated with entering or leaving the defense contract business.

Some of the barriers to entry into the defense acquisition business, as identified by Jacques Gansler, include: the very different type of market associated with R&D acquisitions; the inelastic demand of the R&D environment; the brand loyalty sustained by some branches of the government with some particular contractors; the demands for higher performance required by the very competitive R&D environment; the need of personnel with great engineering/scientific capability; the expenses associated with the initial capital investment in equipment and facilities; the need for large capitals investments by private corporations to be able to service R&D efforts; the ever changing market environment; the constant changes in policies and regulations; political factors associated with R&D; budget fluctuation; and the amount of security clearances required to perform in many areas of R&D procurement (48:4-13).

Some of the barriers encountered by firms that try to leave the R&D business, as identified by Jacques Gansler, include: financial investments already incurred in R&D; the investment in capital equipment incurred by the firm; the lost-opportunity to acquire a long-term contract; the specialization of employees in R&D; the unfilled orders; the emphasis of quality over quantity; the sales; and maybe even the patriotism of the firms (48:4-13).

A problem faced by many firms that compete for R&D contracts is the risks associated with the DOD push for

competition. Many contractors feel that guaranteed work and profits have been replaced by a shrinking defense budget, competition for available programs, and new requirements (37:10). Many contractors feel that this new strategy places them in a no win situation in which they cannot afford to relinquish major R&D programs and at the same time risks taken by the company could become disastrous (37:10).

The firms that engage in R&D acquisitions are vulnerable to changes dictated by the government. These firms try to maintain a competitive edge in this insecure world of contracting.

At the present time it appears that the R&D industry is developing a new look. There appears to be a new profile for the typical worker in R&D (34:78). In a survey conducted by R&D Magazine, it was determined that the R&D worker tends to be younger, less experienced, and has not been employed by the company very long (34:78-80). These facts could be a result of the early retirement programs that have been offered to senior personnel in the recent past (34:78-80). In this study, it was viewed that R&D employees with advanced degrees have a distinct advantage over employees with a bachelor's or less than bachelor's degree (34:79). These facts tend to portray the new look on R&D. This survey demonstrates the advantage of acquiring advanced degrees and shows the trend of a younger R&D working force.

The following section will discuss the importance of small businesses in R&D. These firms have contributed

immensely in the areas of basic research and exploratory development.

Small Business and R&D. The role of small businesses in the area of R&D procurement, especially basic research and exploratory development has been immense. These corporations have been recognized as excellent technological innovators in R&D (12:507). The engineering and scientific talent, and the dedication of the personnel in these institutions provide them with a better competitive edge when dealing with R&D research activities (40:15).

The importance of small businesses is centered around the talent of people that work in these corporations. These people are specialists in a specific branch of science and/or technology and possess the desire to specialize, create, and be technologically innovative (32:4). Most of these firms, if successful, become the prime contractors of the future (32:4).

The history of the United States is living proof that the economy of this nation was founded by small businesses. Studies performed in 1982 indicate that small R&D firms produce an average of twenty-four times as many innovations in technology per R&D dollar as large firms (12:507; 40:14). This trend of small business superiority over large businesses in the discovery of new technology appears to be constant throughout the history of this nation (12:507-511).

The history of R&D procurement has demonstrated that the larger the organization the poorer their performance in R&D

(40:14). Readers should not be surprised by this fact. At any level, the people that work in small businesses are much more competent than those in larger corporations (40:15). This situation is a result of the necessity of small businesses to be this way, since small businesses do not have a reserve of workers to fall back into for support (40:15).

Another factor that contributes to the superiority of small businesses over larger corporations is that chief engineers in small firms devote most of their time to engineering work. In large corporations, chief engineers usually do not have anything to do with the actual engineering work (40:15). In large corporations the better engineers are promoted out of the engineering field into management and this situation is not seen in small businesses (40:15).

But regretfully, there are many factors that impede small businesses efforts to conduct R&D business with the federal government.

Small businesses must fight an uphill battle with the federal government in R&D procurement. Most of the dollars spent in government R&D go towards the development stage of a project, not to basic or applied research (49:3). Basic and applied research are the strong activities of small businesses (49:3). Most of government R&D dollars go to large businesses capable of performing large development contracts (49:3). When money is made available for R&D research, small businesses have to compete with educational

institutions, federally funded research and development centers, non-profit institutions, and large businesses (49:3).

Besides the above, many other problems affect the ability of small businesses to compete in government R&D procurement. The most common of these problems include:

* the policies, regulations and procedures used by different government agencies
* beliefs, biases, practices of federal R&D people and their management systems
* the advantages of large corporations over small businesses in the government marketplace
* the cost of proposal preparation
* the difficulty of some small firms to respond to the government's R&D requirements
* the instability of the government's budget, and
* the burden of some administrative requirements imposed by the government (12:507-511; 49:3-6).

All of these requirements place a big burden on many small businesses. The end result of the above is that some very competent small businesses opt to leave the R&D procurement process (49:3-6).

The personnel interviewed from RADC were asked to comment on what they felt was the role of small businesses in R&D. Most believed that small businesses play a very important role in basic and exploratory development in R&D (33; 38; 45; 50; 62; 66). Some comments tend to indicate that these firms can do a better job than big businesses; the people involved in R&D research are usually very interested and dedicated (25; 66). Small firms can do a better job

because in many instances large corporations are not interested in very basic research (33). This situation allows for small businesses to move ahead and excel in R&D basic research procurement (33; 62).

A very good characteristic of small businesses and R&D is that most of these firms are founded by scientists and engineers that used to work for larger firms. These individuals possess the desire to dedicate themselves to a specific area of research and technology (33; 45; 62; 67). This desire and intellectual ability places these corporations in a very privileged situation.

Another good characteristic of small businesses mentioned by personnel from RADC is that these firms usually have very low overheads and are able to perform studies at a lesser cost to the government (56; 57).

Some concern expressed by RADC personnel when dealing with small businesses is the necessity of contracting officers to take a more aggressive role when dealing with these firms (59). The contracting officer should have the opportunity to spend time researching the capabilities of a small firm to perform effectively and efficiently the R&D effort. But, instead the restrictions imposed in the R&D procurement process force the contracting officer to contract for the evolutionary idea rather than the revolutionary one (59). It was expressed that small businesses offer the best opportunity to search for this revolutionary idea (59).

Other problems expressed during the interviews on small businesses deal with the problems encountered by the contracting officer when he is forced to contract with small businesses only (38). This situation tends to hamper the procurement process and sometimes forces the government to accept mediocrity in order to advance small businesses (62; 67). An example of this situation is the recently imposed five percent goal of contract dollar amount to be devoted exclusively to the procurement of small businesses and black minorities.

The final concern about small businesses and R&D raised during the interviews was the lack of underestanding of most of these firms on how to conduct business with the government (67). A solution to this problem would be to create a government program that educates these corporations and places them in a better competitive environment (67).

The preceding paragraphs have discussed the role of small businesses in R&D. Small businesses tend to innovate technology, create new jobs, increase productivity, enhance the competitive edge of products in foreign markets, and stimulate the economy (12:507). In order for this nation to maintain its technological superiority, small businesses have to be favorably exploited to the advantage of this nation.

Educational Institutions and R&D. Educational institutions are a very important instrument in the research or development of technology. These institutions are composed of the very bright, talented, and curious minds

needed to explore new avenues to advance the current technology.

Historically, educational institutions have comprised the backbone of basic research in this nation (6:70). The payoffs of this basic research have been rich. Discoveries range from basic techniques of genetic engineering to advances in superconductivity (6:70). Because of these reasons, the relationship between government, industry, and especially educational institutions deserves greater attention (32:88).

Research universities in the United States account for more than sixty percent of the nation's basic research (24:49). This fact could be a result of the ability of educational institutions to attract students and faculty from all over the world (24:49). Some of these students and faculty members are eager to conduct research and dedicate their time to the pursuit of advancements in technology.

But, in government R&D the picture is not good. A big problem encountered by educational institutions is the apparent trend of the government to push ahead with mega-projects and let basic research lag behind (24:49; 32:88). Basic research is the strongest ability of educational institutions. In this type of research, institutions dedicate most of their laboratory time.

The above trend towards mega-projects could create an unprecedented problem to educational institutions. This trend could tie up billions of dollars in a few projects

being performed by large R&D firms and steal from this nation the ability of educational institutions to quickly respond to unexpected discoveries (6:70).

Not all of the improvements to the R&D procurement process have to be initiated or conducted by the government. Educational institutions have to be made aware of the importance of training individuals with practical skills and better basic and applied research capabilities (32:88). These qualifications will be advantageous to the whole R&D process. At the same time, educational institutions need to be aware that R&D development has generally received more attention than R&D research in the government and commercial world (32:88). This indicates that the products of educational institutions should be better prepared in the area of R&D development.

The personnel interviewed at RADC commented on the role of educational institutions in R&D. Most of the interviewees agreed that the role of educational institutions is of vital importance in the areas of basic and applied research for R&D (36; 38; 45; 50; 62).

Another advantage of educational institutions according to the interviewees is that the government is able to contract with some of the top minds conducting basic and applied research in this nation (10; 25; 33; 56). This fact places basic research as a very important and basic need for R&D procurement.

Some problems and/or disadvantages that educational institutions face in the R&D environment were expressed. New government policies forbid government agencies from making awards to educational institutions on a non-competitive basis; unsolicited proposals are discouraged for educational institutions (38).

When a contract is made with an educational institution, the contract is usually between the government and one principal investigator. This situation could present problems to the government contracting agency. The government has to make sure that the principal investigator is committed to the effort (66).

Another problem is that educational institutions are committed to basic research. This situation could create problems if the institutions do not care for the future development of the researched technology into future military systems (45).

Two other concerns about educational institutions and R&D deal with, first, the inability of educational institutions to compete with larger firms because of the lack of resources or management (36). Maybe, these organizations should be allowed to compete by themselves (36). And finally, the lack of understanding by some of these institutions on government contracting procedures (67). This situation could easily be remedied by conducting training sessions with these institutions (67).

Independent Research and Development (IR&D) and R&D. IR&D efforts are innovative research efforts that are initiated, mostly funded, and managed by private defense contractors (26:102). In these programs, the government provides partial monetary reimbursement to investments made by private contractors in R&D research studies if such studies are proven to contribute to national security (26:102; 51:8). The partial reimbursement of these investments is made through negotiated overhead pools up to a negotiated ceiling covering this subject. This action is pursued by the Government, because national defense has been determined to be a public good (51:8).

The pursuit of IR&D projects by private industries is of vital importance because these research efforts ensure the flow of new concepts, products, and systems (5:33).

IR&D is considered by private industries as an investment in the future. This effort is not considered an optional alternative for private corporations (5:33). IR&D insures the competitive position of private investors by exploring new technology to advance or improving existing products (5:33). It is considered a necessity for private corporations to stay competitive (5:33).

IR&D funds allow private industry to apply its resources selectively. It allows the private firm to pursue studies in areas of technology where it is expert, interested, and very competitive (5:33). The success of these efforts will end up benefiting both the company and the consumer (5:33).

A very big drawback to IR&D efforts expressed by private industry is the limited amount of cost reimbursement for these efforts that is allowed by the government (5:34). Private industries believe that IR&D is a necessary cost of doing business and these costs should be recovered completely as an overhead expense (5:34). The U.S. government does not agree with this interpretation and instead imposes an annual ceiling on the ability of the private contractors to recover these costs (5:34; 29:80). Currently, the DOD averages a reimbursement to contractors of only forty percent of the amount spent in IR&D efforts (5:33). Any costs that are incurred over the agreed ceiling are not recognized by the government as an allowable cost, and subsequently are not even partially recoverable (5:34).

Another problem encountered by IR&D investors are the constant changes in the government procurement process. These changes have increased the contractor's financial risk and have reduced the amount available for investment in IR&D (5:35). Some examples of these changes include:

* the changes in profit policy whose objective is to reduce profits

* cost-sharing requirements between the contractor and the government

* the use of fixed price contracts for development programs

* the reduction in progress payments from 90% to 75% for large corporations

* the increased amounts of unallowable costs imposed by the government, and

* the investments required of private contractors for the acquisition of special tooling and equipment (5:35-36).

A way in which the IR&D process could be improved is by allowing IR&D costs to be fully recoverable by private industry in an overhead account (5:36).

Since IR&D is considered to be a vital part of the R&D process, its importance should not be de-emphasized. The future of technological superiority in this nation hinges in part on the success of IR&D efforts.

R&D Statements of Work

The most critical aspect of an R&D contract document is its description of the government's requirements (60). This description has to be clear enough to describe the contractor's specific obligations in reference to the subject effort (60). Failure to accomplish this objective could result in poor performance by the contractor and could make the contract a burden to the contract administrator. If the requirements of the contract are not interpreted equally by both, the contractor and the government, there is a very good probability that claims and disputes will develop during the life of the effort (64:104). These requirements are specified through the Statement of Work (SOW).

There are three general categories of specifications used by the government to specify requirements in a SOW. These three categories govern the contractor in the performance of the contract. Also, these categories provide the basis for evaluating the contractor's compliance with the

government's requirements (64:104-105). These categories are:

1. <u>performance specifications</u>: here the SOW expresses its requirements in terms of standards of performance or functions that the end product should be able to perform (60). Performance specifications are composed of performance and operational characteristics of the product. Risk of performance is placed on the contractor.

2. <u>design specifications</u>: in these specifications the physical characteristics of the end product are detailed in the SOW (60). In these specifications, complete drawings and physical characteristics of the end product are detailed. The risk of performance is placed on the government.

3. <u>functional specifications</u>: these specifications are similar to performance specifications but are not constrained by any design detail (60). They describe the end use of the desired item in order to stimulate competition.

In Research and Development contracting, where the emphasis is on the advancement of scientific and technical knowledge and the application of this knowledge to national goals, the SOW is of vital importance. In R&D procurement the SOW is probably the most influential document (14:4).

As mentioned earlier, the SOW is the Government's description of its objectives and requirements for the desired effort. This document must provide sufficient guidance to evaluate the contractor's performance and at the same time be broad enough to encourage the creativity and flexibility of the contractor (14:4; 64:110; 37; 44; 63; 66).

The SOW plays a very significant role during proposal preparation and evaluation, contract selection, and contract administration (64:110).

The preparation of the SOW should be the product of a team effort between project and contracting offices. Failure of the officer's in these offices to work as a team will most probably result in complications throughout the life cycle of the R&D procurement (14:4).

Personnel preparing the SOW should always bear in mind the importance of drafting an adequate SOW. This SOW shall be adequate for the government, the procurement process, and the prospective offeror (14:4). In R&D competitive efforts, where SOW compliance is a must, it is unlikely that the contractors will provide more than what has been requested by the SOW. This fact dictates that the SOW has to be prepared in a clear and precise manner in order for the government to obtain the best product for its dollar (14:4).

Most R&D programs are usually somewhat intangible and and subject to change. This dictates that the SOW should always "be able to describe the objective, purpose, nature, and requirements to the extent available for the work to be performed" (6:4). If the SOW is too restrictive, some sources will probably refuse to participate in the procurement. Having an SOW that is too restrictive for R&D would probably result in a feeling by the contractor that his creativity is being hampered (14:4). At the same time, if the government does not draft the SOW definite enough, some contractors will decide to stay away from this effort. Many contractors feel that having an SOW that is too broad places

too much risk on the contractor and/or forbids him from relating the requirement to his own capabilities (14:4).

Because of the above, it is very important to plan the SOW before it is drafted. The drafter(s) should review the literature available and/or related to the subject, and review any similar programs that have been developed by other government agencies (14:4). These actions could help in the definition of the requirements for the SOW (14:4). These reviews will be very influential in dictating the type of contract to be used in this effort (14:4). For example, if the performance period and cost goals are uncertain, then the best alternative would be to use a cost-sharing type of contract.

After conducting the pre-planning steps of the SOW document, a formal planning of the same should be conducted. This planning stage should clearly, concisely, and most completely define the requirements and obligations of the contracting parties (14:4). In order to successfully accomplish this planning stage, an outline of the SOW would be a good start (14:4). This outline would provide the drafter an opportunity to study and analyze ideas before formalizing the SOW. Some advantages of an outline:

1. Serves as an aid in the analysis of the writer's ideas concerning the work requirement (14:4).

2. Serves as an aid in organizing the description of the work requirement to provide smoothness and continuity (14:4).

3. Helps guard against significant omissions (14:4).

4. Helps in screening out unnecessary and redundant material (14:4).

5. Frees the writer and directs full concentration to the area of interest (14:4).

Some factors that should be considered when planning the draft of the SOW include:

1. General scope of work

2. Contractor tasks

3. Contract end items (if any for R&D).

4. Place of performance

5. References to researched background in pre-planning stage

6. Progress reporting requirements

7. Data

8. Any support material or equipment needed for the effort

9. Any government furnished items

10. Exhibits or attachments to the SOW

11. Period of performance

12. Requirements of end items (if any) (64:111-112).

The above factors will be very influential in the future success of the effort.

Once the planning stage of the SOW is completed, the preparation of the SOW should follow and is crucial to the success of the R&D effort. The final SOW should be clear and concise (14:4). The inclusion of the following factors should be considered when preparing the SOW:

1. Background information necessary to a clear understanding of the research requirement and its history (14:4).

2. Description of any technical considerations which could influence the contractor's effort or direction of approach (14:4).

3. The establishment of meaningful parameters of measurement to be used in the effort (14:4).

4. Clear definition of deliverable end items and time of delivery (14:4).

5. Any other special consideration being utilized in this effort (14:4).

This final stage before writing the SOW is crucial. If the requirements are not clearly specified, many problems could surface during the life cycle of the procurement. Ambiguities in the SOW could lead to contract interpretation disagreements, contract administration problems, protests, disputes, and claims (64:112).

Many of the ambiguities on the government's requirements are caused by:

1. Lack of well performed advance planning

2. The use of inadequate specifications

3. SOW's that are too wordy and do not describe with sufficient detail the government's requirements

4. The changing nature of the product or service requested by the government

5. Urgency to satisfy government's needs

6. Lack of communication between bidders and offerors in the request for proposal phase

7. Absence of pre-award conferences by the government (64:112).

Most of the above factors can be corrected by properly conducting the steps mentioned in this section. After preparing the SOW, the final stage is writing it.

The writing of the SOW is very dependent on the way that the previous stages were performed. Additionally, the writing of a good SOW is very dependent on the capabilities of the writer.

The SOW should be written as clear and concise as possible. Some common problems in writing the SOW include:

1. Sentences and paragraphs that are too long and unwieldy
2. The use of unnecessary abstract words
3. Vague and ambiguous terms
4. Material that is used in excess and is unrelated to the effort (14:4).

A well written SOW should include the following:

1. Use mandatory language properly
2. Make an SOW just as long as necessary
3. Try to use short understandable sentences
4. Use familiar words as much as possible
5. Try to make the SOW as simple as possible
6. Eliminate use of unnecessary words
7. Use action verbs when possible
8. Use graphic terms
9. Write to express rather than to impress (14:4-11).

If all of the suggestions mentioned above are considered, a relatively useful SOW should result.

The importance of the SOW to the R&D acquisition process was discussed with the interviewed personnel at RADC. All of the interviewees commented that the SOW was one of the most important if not the most important aspect of R&D

acquisitions (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 59; 62; 66; 67). At the same time, some of the interviewees felt that not enough emphasis was placed on it (45; 66).

Some of the interviewees expressed some concern about the people who write the SOW's. These people are usually engineers who have not been trained in the writing of an SOW (64; 66). An alternative to this problem would be to provide training to these personnel (36).

Another comment made on SOW's for R&D procurement is that many times the contractor's technical proposal should be converted to the government's SOW and incorporated by reference into the contract (25).

In R&D a well-planned and properly prepared SOW should minimize the possible problems that could occur during the life of the effort (14:4). For example, a poorly written SOW would most probably create problems that will ultimately result in higher costs to the government.

Technical Evaluation Criteria and R&D

Today's R&D efforts have to be well planned and evaluated. Typically, the time required by the government to transition technology into weapon systems ranges somewhere between ten to fifteen years (50:53). This factor combined with the present economic pressures of this nation have made the technical evaluation criteria used in R&D RFP's a very important factor in the acquisition process. The evaluation criteria should aid government agencies in becoming more effective by helping to choose the technologies with the

highest potential to succeed. The Technical Evaluation Criteria provides the contractor with the terms and conditions that will be used when evaluating the proposal submitted for the R&D effort.

The Technical Evaluation Criteria consists of the evaluating factors for the RFP, a scoring and weighing system for these factors, and the organization and procedures to be used by the technical evaluation panel (14:4; 63:102-104).

In order to establish the above criteria, a technical evaluation plan has to be developed early in the procurement process. This plan is to be created prior to the preparation of the RFP (64:102). The early preparation of the plan will help make sure that the RFP is compatible with the evaluation criteria. Also, early preparation will allow appropriate emphasis to be given to the different factors of the evaluation criteria (14:4).

It is very important that the drafters of the Technical Evaluation Criteria possess the ability to assess the relative importance of the factors utilized in the evaluation of the technical proposal (14:4). It is also necessary that the evaluators of the technical proposals acquire a very good understanding of the effort as detailed under the scope of the SOW and performance schedule (14:4).

The evaluating factors established in the Technical Evaluation Criteria should be discriminatory between the offerors; different scores for different proposals (64:102). The evaluation of these factors should be a reflection of the

contractor's understanding and compliance with the requirements of the RFP (64:102). These factors that are scored under the technical evaluation criteria of the RFP should be kept to a minimum; too many factors tend to balance out different proposals (64:102).

The evaluating factors can be subdivided into sub-factors. These sub-factors should help the primary factors and assist the offerors in understanding what information is desired by the government (64:102). These sub-factors should be kept to a minimum for the above same reasons.

Once the factors and sub-factors for the Technical Evaluaticn Criteria are selected, weights are assigned to these factors and sub-factors. The sum of these weights usually adds up to the whole amount (14:4).

The followi. _ is a typical example of factors and sub-factors typically used in the evaluation criteria of the RFP:

1. Scientific/Technical Approach
    a. Understanding of the problem
    b. Soundness of approach
    c. Compliance with requirements
    d. Identification and suggested resolution of major problem areas
    e. Special technical factors (innovative solutions, simplicity) (14:4; 64:103)
2. Qualifications of the Offeror
    a. Experience
    b. Technical organization
    c. Facilities

d. Equipment

e. Personnel (14:4; 64:103)

3. Offeror's past experience

a. Technical

b. Quality

c. Compliance

d. Cost history

e. Problems (14:4; 64:103)

The above is a very general example of a Technical Evaluation Criteria. More factors and sub-factors could be used in the evaluation criteria. The most important aspect of the evaluation criteria is to be able to establish appropriate and well balanced evaluation criteria for the desired effort (64:103). The evaluating factors should deal directly with technical considerations (64:103). Cost factors should not be weighted factors in the technical evaluation of an offer (64:103).

The interviewed personnel at RADC had some comments on the importance of the technical evaluation criteria factors in the R&D process. All of the interviewees expressed that the technical evaluation criteria factors are very important to allow the offeror to know how the government intends to evaluate the proposal (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 59; 62; 66; 67).

Once the evaluation criteria to be used in the RFP are set, no deviations are permitted (62). The criteria serve as a guideline for government personnel to debrief unsuccessful

contractors and point out mistakes or misconceptions in the proposal (62).

Another very important aspect of the evaluation criteria in R&D is that most of the R&D awards are technical awards. Cost is important, but not as important as the technical proposal (50; 67).

In summary, the Technical Evaluation Criteria for R&D is of critical importance. A well planned criteria will provide the government with the best proposal for a particular effort. If the criteria are not drafted correctly, the selected proposal would not be the best choice for the desired research.

Source Selection and R&D

When an RFP for an R&D effort is issued by the government, the interested parties are usually allowed thirty days to submit a proposal (39:18). Some exemptions apply under certain circumstances. The interested parties are usually required to submit a technical, management, and cost proposal in response to the RFP (39:18).

Once the proposals are received by the government, a source selection panel is convened to evaluate the submitted proposals against the evaluation criteria in the RFP (11; 39:14). Negotiations will take place with the contractor(s) still in contention after the initial review (11).

For R&D procurement, the above panel is usually composed of government technical personnel that are familiar with the effort. The chairman of the source selection panel is

usually the technical initiator (39:15). This panel will evaluate all segments of the contractor's proposal and make a recommendation to the Source Selection Authority (11). This individual is usually the contracting officer for small R&D efforts.

During the evaluation of the contractor's proposal, technical questions are often drafted concerning the proposal. These questions are generally submitted to the particular contractor and responses received in writing. This questioning process is very formal and does not allow for the technical personnel and the proposing contractor to dialogue and obtain a better understanding of the issues and problems in the proposal (39:15).

The scoring method used by most selection panels when evaluating the submitted proposals is quantitative. Since R&D emphasizes technological performance, most of the points in the Technical Evaluation Criteria are assigned to the technical components of the proposal (39:15).

After completion of the evaluation, the source selection panel submits its scores to the contracting officer (39:16). At this stage, negotiations are initiated with the contractor(s) still in contention. These negotiations discuss the technical issues raised by the source selection panel along with the cost and/or related delivery issues (39:16).

If any changes are made to the proposals, the source selection panel will re-evaluate the proposal and make any applicable changes to the contractor's ranking.

Once the final scores and best and final offers are received, the FAR requires that the contracting officer make award of the contract to the source whose best and final offer is most advantageous to the government, cost and other factors considered (39:16).

The interviewed personnel at RADC commented that the Source Selection process in R&D is very important (33; 36; 38; 50; 56; 57; 67). This process is aimed at acquiring the services of the best available contractor to perform the effort (33; 38; 57).

Presently, the procedures being used for Source Selection in R&D efforts are described in the Air Force Regulation 70-30. This regulation is more rigorous than the previously used Air Force Regulation 70-15 (36). It allows for the use of fresh thinking and steers the process away from a lot of politics (36).

Air Force Regulation 70-30 provides streamline procedures for source selection for efforts that fall below the dollar thresholds described in Air Force Regulation 70-15. These thresholds were identified as $200 million Research, Development, Test and Evaluation funds and $1 billion production funds in fiscal year 1980 constant dollars (13:3). In terms of fiscal year 1988 then-year dollars, these thresholds were close to $300 million for Research, Development, Test and Evaluation funds and $1.6 billion production funds (13:3). It provides policies, general objectives, and procedures to be implemented when using this

regulation. This regulation stresses the use of less resources by limiting the number of discrimination factors and items, limiting the size of the proposals, and reducing the size and complexity of the source selection process (13; 15).

Once all of the evaluation criteria for the RFP have been applied, the next step is to determine the appropriate contract type for the particular acquisition.

R&D Contract Types

There are two ways in which a contractor can obtain an R&D contract with the government. The first way is on an exception basis where the contractor presents an unsolicited proposal to a government agency (39:11). The award of a contract to a firm offering the unsolicited proposal can be successful if the proposed idea is considered to be unique and the offering contractor has expertise in the proposal's subject area (39:11). The second and most accepted way to obtain an R&D contract with the government is by having the interested contractors respond to a request for proposal (RFP) issued by the government. This method is widely accepted because of its competitive nature (39:11). But, in the event that only one acceptable offer is received, the process could become non-competitive (39:11).

Contract types for R&D contracts range from fixed price type contracts to cost reimbursable type contracts. Fixed price type contracts are usually the preferred government contract type (11). This contract type place the maximum

cost risk on the offering contractor. Cost reimbursable type contracts place the cost risks on the government (13). Cost reimbursable type contracts are not preferred for most contracts with the government, but they are probably the most desired contract type for R&D acquisitions.

Fixed price contracts and cost reimbursement contracts are the two extremes of a contract type continuum used by the government. In between these extremes lie a number of derivations of these two main contract types. R&D has used a broad range of contract types in an effort to optimize R&D procurement. Some examples of these contracts include: Firm Fixed Price (FFP), Fixed Price Level of Effort (FPLOE), Fixed Price Incentive Fee (FPIF), Fixed Price Award Fee (FPAF), Cost Plus Fixed Fee (CPFF), Cost Plus Incentive Fee (CPIF), Cost Plus Award Fee (CPAF), and sometimes a hybrid combination of these contract types (11).

The determination to use any particular type of contract is based on the risks encountered in performing the effort. Contract risks are possible potential problems with costs, technical capability, or performance schedule (11).

R&D contracts are geared towards the advancement of technology, indicating that a great amount of risk is to be encountered by the contractor performing this effort. This fact seems to imply that cost reimbursem type contracts should be the method of choice for R&D.

In Research and Development acquisitions, the need of the government is usually expressed in broad terms which

makes FFP type contracts very risky for private contractors (67). Nevertheless, this method of contracting has traditionally been the Government's choice for most of its acquisitions.

In interviews conducted with contracting personnel from Rome Air Development Center various opinions were given on the use and choice of different types of contracts for R&D. One recurring opinion among all the people interviewed was that the government imposes too many constraints on the ability of contracting officers to choose the best type of contract for diverse R&D procurement (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 59; 62; 66; 67).

Most of the interviewees expressed that the contract type to be used in R&D should not be pre-determined (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 66; 67). The selection of the contract type should be based on risk and degree of specificity of the desired program or project. The contract type decision should be made on each particular contract as the differing circumstances dictate.

Some of the interviewees expressed their desire to have the threshold of FPLOE contracts increased from its $100,000 ceiling. These contracting officers believe that FPLOE type contracts are not a bad choice for small dollar R&D studies (10; 33; 45; 66). This type of contract was expressed to be desirable by some CO's because of its simplicity of administration. FPLOE contracts are a hybrid form of fixed

price type contracts in which the government buys a specific amount of hours from a contractor for a particular R&D study.

Contracting officers interviewed at RADC agreed that fixed price type contracts were a good choice for basic research and exploratory development studies (10; 36; 50; 56; 66). The product of most of these studies is a report. Some of the contracting officers were dissatisfied at the constraints recently imposed by the government on these types of contracts. At this time, R&D contracts to be awarded under FFP provisions need to be documented in the contract file (36). FFP contracts would be very good for R&D programs of low cost, $200-$500k, even though a good Statement of Work could not be produced (10). This determination could be derived from the feeling that most of the contractors in the R&D market are eager to provide the government with a good effort in the performance of an R&D effort and not underestimate the task (10). Another new constraint on fixed price contracts imposed by the Defense Appropriations Bill is that for R&D contracts over $10 million, approval must be obtained from higher headquarters (38).

For R&D efforts that require more than just a study, most of the contracting officers interviewed preferred a cost type contract (10; 33; 36; 38; 42; 45; 50; 56; 59; 62). The disadvantage of cost type contracts is the administrative burden that these contracts place on government personnel. Many times it takes years to close-out this type of contract,

due to disagreements on the final contract audit performed by the government.

The preferred method of contracting for large and costly R&D efforts, suggested by the RADC personnel was cost type contracts (10; 33; 36; 38; 42; 50 62; 66; 67). Cost type contracts were the method of choice because they create a sharing of the contract risk between the contractor and the government. In most instances, the government does not have concrete specifications for the end product. Most of the time, the Statement of Work is not specific enough to grant the use of an FFP type contract. Cost type contracts are viewed as a better choice because of the financial risks imposed on the contractors by the government. Some examples are the shrinking budgets, and the deficits encountered by the government. Most interviewees believe that greater flexibility for R&D can be obtained by cost type contracts (10; 25; 33; 36; 38; 50; 66; 67). One of the interviewees commented that by using fixed type contracts for R&D procurement, the government is not really saving any money because the contractors usually recoup their risk by submitting higher prices or increasing its overhead pools (62). Besides, the use of FFP contracts usually hurt the advancement of new technology because the contractors are not willing to venture into fields that could become risky and are not specified in the requirements of the SOW (56).

One type of cost reimbursement contract that is gaining in popularity in the R&D arena is the CPAF. This type of

contract awards some extra profit to the contractor if money is saved during performance of the effort. CPAF seems to work very well for large dollar amount R&D contracts, but does not seem to be of great savings for small R&D studies.

Another type of contract being used for small R&D studies is the Time and Materials (T&M) Contract. This contract type utilizes a pool of time and material available for contractor use. This type of contract was not well liked by most of the personnel interviewed at RADC because it does not provide the contractor with any incentive to reduce costs.

Another type of contract that has been used in R&D is the CPIF contract. The use of this type of contract appears to be on the decline (10). This type of contract uses an incentive that measures costs. Since the object of R&D is to push technology, technology in this type of contract usually lag behind (59). A good way to improve this contract type would be to offer multiple incentives.

In summary, for small dollar programs, the preferred type of contract for R&D studies and R&D basic research and exploratory development has been determined to be a type of fixed price contract. In the intermediate dollar range of R&D contracts, some hybrid of fixed fee and cost contracts would be the preferred method. For large dollar R&D type contracts, the preferred method of contracting is a cost type contract. If the choice is between a fixed price contract and a cost type contract for R&D, the preferred method is a

cost type contract as expressed by the interviewed personnel at RADC. This type of contract makes more sense due to the inability to specify an end product in R&D.

Competition and R&D

Historically, the amount of money spent in R&D efforts in the U.S. has been enormous. In 1988, it was projected that government R&D spending would sum up to be $65 billion; industry would spend $63 billion; educational institutions would spend $2.9 billion; and other agencies would contribute $1.5 billion (26:74). This amount adds up to close to $132 billion spent in R&D procurement in 1988.

Because of the amount of money involved in R&D, contracting for government R&D funds has traditionally been very competitive (39:8). But the term "competition" in the past is different from the term "competition" in the present. In the past, competition was big because R&D was considered by many contractors to be the first step in securing future production business that followed the R&D process (39:8). Private industry's view of competition was to provide customer satisfaction and technological innovation (65:181).

In the past, most of the contracts awarded to private industry used to be solely on a cost reimbursable basis. This situation was well liked by private industry, since the risk placed on the contractor during contract performance was minimum (39:9).

The trend in R&D contracting started to change with the Competition in Contracting Act (CICA) of 1984. This act was

adopted by Congress, because they perceived that competition was not being used correctly when awarding defense contracts (23). This act has changed the method in which most defense contracts are awarded. CICA has particularly affected R&D because competitive proposals are used as the method of contracting for R&D procurement (11).

The competitive proposal method consists of basically sending out an RFP to interested parties, receiving and analyzing the submitted RFP's, discussion of the technical requirements, and negotiation of a final contract with the successful offeror (11). The objective of this selection process is to present a solution which may advance the state of the art, amplify the technical expertise of the contractor, or be of proprietary nature (31:9).

In the past, many of the contracts for R&D were results of sole source negotiations or unsolicited proposals. In these types of contracts the government was forced to accept and be content with the limited capacity of the offering contractor (31:9). This situation was seen as a disadvantage by government officials.

Today's approach to R&D contracting is very different. The Congress and DOD have changed the rules of defense R&D procurement. This action is based on reports of contractor overcharges and wrongdoing, and the shrinking of defense budgets (37:10). This shrinking of defense budgets will most likely lower the amount of funds usually spent in R&D over the next five years (29:78).

The historical era of guaranteed work at guaranteed profits by DOD contractors has disappeared and has been replaced by fierce competition for programs, and new requirements that force contractors to invest their own money in various programs (37:10). These changes are forcing contractors to trim their costs and get ready for the cuts in defense R&D spending (68). Contractors believe that these changes are here to stay and subsequently are getting ready for the implications of competition (68).

There are mixed feelings about the new competition for R&D contracts. This concept is not well taken by some contractors and government personnel. Many government program managers resist the use of competition because of the substantial time and effort required for effective competition, and the belief of some that competition does not accomplish its purpose of selecting the best technical offer at an acceptable cost to the government (30:33). They contend that competition causes the low-cost bidder to win the contract instead of the best choice for the government (30:33). Many opposed to competition believe that low-cost means inferior performance (30:33).

Many contractors believe that the procurement changes place them in a no win situation: they cannot afford to pass up a major program, but the risks associated with the programs are very high (37:10). To most contractor's R&D represents a big up front investment which could have a very adverse impact on the firm's financial position and could

cost the firm their ability to compete in further R&D efforts (2:139).

Some of the advantages of the new competition approach are expressed by competition advocates and critics. Many advocates insist that defense contractors complain too much because they are having to experience a rough transition from a wasteful period of sole-source defense purchases to the new competitive period in contracting (37:11). The previous period was characterized by contractor abuses and inflated costs (37:11).

One realization made by DOD officials in reference to the contracting strategy is that fixed price contracts have gone too far. This problem has been partially corrected by discouraging the use of fixed price contracts for R&D when they exceed $10 million. This year's Defense Authorization Bill contains a provision requiring higher headquarters to authorize the use of fixed price contracts for research when they exceed $10 million (29:80).

A couple of lessons that are being learned by defense contractors is that it now takes lower costs, and not just technical superiority to win an R&D contract (68). In the article titled "A perilous cutback in research spending" it was suggested that "those that do not cut back may find themselves sailing rough waters in tomorrow's global markets" (43:140).

Secretary Cheney's report has suggested two ways to improve DOD's competitive practices. First, it would clarify

existing laws governing the acquisition process (9:20). Secondly, it proposes the implementation of a contractor performance review process to expand the source selection criteria and promote DOD's relationship with the best suppliers (9:20).

Roles in R&D Contracting

Three different government officials contribute to the success of an R&D program. These officers are the contracting officer (CO), the program manager (PM), and the contract administrator. In R&D, these officers have to work as a team in order to successfully accomplish R&D's objective of maintaining technological superiority.

The success of an R&D effort is closely related to the management effort performed by these individuals (11). Up to the award of the R&D contract the only work that has been performed is an exchange of promises between the government and the successful contractor (11). As soon as the award of the contract is formalized, the promises made by both parties must be converted into action (11). This conversion initiates the longest phase of the contracting process, the contract management of the effort (11).

After award, the contractor is responsible for accomplishing the objectives of the RFP. But, the Government is still interested in overseeing the progress of the contractor. Usually, the government goes on checking the contractor's progress throughout the performance period. Government oversight encompasses:

* quality assurance
* inspection and acceptance of products
* monitoring of financial status
* adherence to the contract schedule
* oversight of the subcontracted portions of the effort (if any), and
* making sure the contract is conducted as agreed (11).

These activities are carried out and shared by the CO, PM, and Contract Administrator.

Contracting Officer's Role in R&D. The DOD contracting officer is the individual that is legally authorized to enter into a contract on behalf of the U.S. Government. This authority flows from the government's essential nature as a political entity as authorized by the Supreme Court (16:30). The authority to contract is acquired by the CO through the warrant system (16:30). This system authorizes the CO to bind the government to a contract up to the monetary amount specified in such warrant. The CO's authority is further limited by legislation and implemented in accordance with the Federal Acquisition Regulation (4:26).

CO's are responsible for conducting contract negotiations, the signing of any official correspondence addressed to the contractor, and the issuance of unilateral changes pursuant to the Changes clause in the contract (4:26). They are authorized to stop work or terminate a contract unilaterally; they make the final determination on any disputes with the contractor (4:26). But, the affected

contractor can appeal this decision to the Board of Contract Appeals or the U.S. Appeals Court (4:26). The trust given to the CO to make all of these contractual decisions imply that he/she has been given significant authority and responsibility as the agent for the government (4:26).

Lately, there have been some concerns over the authority of the CO in DOD. There is a belief that the CO's authority has been hampered by increasing oversight and review of the CO's work, constant changes in the acquisition strategy, diminishing authority, lower public and peer regard, and some "bad press" (16:29-31). Other criticisms have been directed at the relatively low pay grade and low organizational status of these individuals as compared to private industry or Civil Service personnel (16:29).

The effect of increasing oversight in CO's work has discouraged the application of business judgement and innovation of the CO (16:30). This increase in oversight encourages tentativeness and deference, not decision-making (16:30). Some contractor personnel believe that the CO's role has eroded to the point that they are becoming a bridge to transmit decisions that have been made by others (16:30).

CO's face problems with changes in the procurement process and the new rules and regulations attached to these changes (16:30). These changes have resulted in a diminishing of the authority of the CO to act within his/her position of authority (16:30). The increases in legislation and regulations in the procurement process will probably end

up leading to less efficiency by the CO. These changes will also lead the CO to focus attention to the administration of the contract rather than dedicating his/her efforts to the acquisition of the best deal for the government (16:31). The effect of these changes in the CO's authority tend to conclude that CO's are becoming machines instead of humans using imagination, judgement, and common sense (16:31).

During the interviews at RADC, the role of the CO in R&D was discussed. It is the belief of the interviewees that the CO is a critical part of the R&D process, possesses very distinct responsibilities, and is the individual responsible to see that the contracted work is accomplished (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 62; 66; 67). Most of the personnel interviewed are of the belief that the CO should have more authority to act unilaterally in order to acquire the best deal for the government (10; 25; 38; 50; 59; 66; 67). Some believe that their authority is being hampered by political circumstances and technical matters (38; 42; 56; 67).

The importance of team work between the CO and PM was stressed by the interviewed personnel (10; 33; 36; 42; 45; 56; 57; 62; 66; 67). It was emphasized that the success of small R&D efforts hinges very much on the realization of the CO and PM that they are both part of the team (10; 33; 36; 42; 45; 56; 57; 62; 66; 67).

Program Manager's Role in R&D. Program Managers are the individuals who possess the overall authority and

responsibility for managing system acquisitions (4:26). This authority is subject to various controls by the government, DOD, policies, and regulations (4:26). Examples of policies and regulations that control PM's authority are: OMB Circular A-109, FAR Part 34, and DOD Directive 5000.2 (4:26). In short, the PM is the individual in charge of obtaining the necessary items to fulfill the government needs (4:26).

The first responsibility of the PM is to develop a written acquisition plan for the acquisition of major systems. This plan consists of an overall strategy aimed at satisfying the government's need (4:26). This overall strategy will mainly consist of estimated costs, budget authorization, and the results of interaction with government personnel in order to obtain needed supplies and services by contract (4:26).

The PM has "centralized management over all technical and business aspects of the acquisition" (16:29). This centralized management authority allows the PM to "monitor and coordinate various activities of government and contractor personnel in the design, production, testing, development, and support of new systems" (4:26). However, PM's lack authority to enter into contracts for the government (16:29). This division of management and contractual authority has generated criticism by the participants of the R&D process (16:29).

The problem presented above could be minimized by providing PM's with more support by the CO early in the

acquisition process, and by making the CO the PM's business planning advisor and representative to the industry (4:31).

For small dollar acquisitions, such as research and exploratory development efforts, the PM takes a different approach to the acquisition of goods and services for the government. During the interviews at RADC, the role of the PM in R&D efforts was discussed.

One of the concerns that CO's have with the PM's at RADC is that PM's are mostly engineers and not managers (67). The major problem with using engineers as PM's is that these individuals lack management training (67). This situation could be corrected by training these personnel before they become PM's.

Another comment made on behalf of the PM's is that these individuals should have authority that relates to technical and performance aspects of the contracted effort, not the management aspect (38; 33; 45; 56; 57).

Contract Administrator's Role in R&D. The role of the contract administrator in DOD starts as soon as the contract is awarded. This function "is a vital part of the acquisition process as well as an extension of the program manager and procuring contracting officer functions" (30:33). These individuals are responsible for making sure that the government receives what it ordered (3:35). The range of the contract administrator's duties encompass all activities that take place during the performance of the effort, and all other activities that relate to the contract,

such as final payment and contract close-out (3:35). The FAR, Sub-part 42.3, lists 61 mandatory tasks of the contract administrator along with eight optional tasks that these individuals could perform (3:35).

Most functions of the contract administrator fall under one or more of the following categories: contract management, quality assurance, production surveillance, payment, and miscellaneous services (3:35).

Contract management personnel are mainly responsible for contract interpretation and enforcement. These individuals approve payments, negotiate rates for overhead and labor, and analyze the contractor's proposal (3:35).

Quality assurance personnel are the individuals who review the contractor's quality control system and procedures, monitor the output of the effort, determine the contractor's performance to government specifications, and accept the hardware produced by the contractor on behalf of the government (3:35).

Production surveillance personnel see that the contractor is on schedule and is complying with contractual delivery. These individuals can advise the buying activity of potential or actual slippage in the delivery schedule (3:35).

Payment personnel are responsible for tracking funds and processing payments both for work in progress and final delivery (3:35). These individuals have the responsibility of issuing the final payment once the contract is closed-out.

Finally, the miscellaneous functions of the contract administrator include property administration, direct support to certain programs, cost tracking, and engineering (3:35).

The contract administrator usually performs all of the above functions. But if needed, the contract administrator can help in other functions such as: pre-award services, program office support, cost monitoring reviews, and cost accounting systems compliance (3:37-38).

The above functions are performed by the contract administrator in most programs. But, due to the duties of these officers and the amount of contracts in the field, these officers are usually under-staffed. This situation usually creates a management by exception attitude (16:29-33).

In many R&D efforts, contract administrators do not get involved in the administration of the contract unless problems surface. The reason for this is that it is very difficult to perform administration on efforts whose product is a report or the expenditure of hours in a study.

Personnel at RADC confirmed that the role of the contract administrator in small R&D efforts is minimal (36; 42; 50; 67). The reason for this is that most inspection and acceptance for the products of these efforts is performed by the PM at the government facility (67). Another reason is that these people are busy with the administration of other types of contracts and do not have the time to spend in small dollar R&D efforts (10; 38; 62; 67). It was the opinion of

RADC officers that the agency would do a better job if they were able to administer their own contracts (38; 57; 67).

It was mentioned by the RADC personnel that contract administrators are not efficiently utilized (38). One problem associated the contract administrator is that these personnel lack the sophistication to administer assigned contracts (62). Another complaint about the contract administrator is that due to their work overload they do not perform their job and do not pay attention to the administration of small R&D contracts (50).

Team work and R&D. The importance of cooperation and teamwork between program managers, contracting officers, and contract administrators for R&D acquisitions cannot be over emphasized. These three officers have the responsibility of obtaining the desired products for the government in an effective and efficient manner.

Contracting officers, contract administrators, and program managers all have one very common characteristic, they must manage the activities of others in order to get their job done (3:27). However, all of these officers have to work together in a non-adversarial relationship in order to get the work done effectively and efficiently.

Contracting officers usually have a very good understanding of the overall program being contracted (3:27). This situation allows for them to have a good perspective of the contractor's requirements and the government's objective (3:27). These characteristics make contracting officers a

very valuable asset to program managers. If program managers take advantage of this asset, overall teamwork and efficiency in the program will improve (3:27).

The utilization of an open door policy, improvement in communication, and allowing contracting officers, program managers, and contract administrators to feel part of the contract manager's team will undoubtedly pay big dividends (3:27).

During the interviews, the concept of teamwork between the contracting officer, program manager and contract administrator was emphasized (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 62; 66; 67). It was expressed that for an effective and efficient R&D effort the program manager and the contracting officer have to work very closely together (10; 25; 33; 36; 38; 42; 45; 50; 56; 57; 62; 66; 67). Contract administrators should pay a little more attention to small R&D efforts. These efforts are the first step in the acquisition of major weapons systems for the military.

Performance Problems and R&D

In basic research and exploratory development R&D efforts, there exist some circumstances that affect the performance of these efforts. Many of these problems evolve from the numerous policies and regulations that have been imposed by Congress on R&D procurement. The numerous policies and regulations imposed in R&D procurement have increased from under 100 pages to well over 3,000 pages (40:18). This increase in policies and regulations has not

yet proven to be an improvement in R&D government procurement (40:18).

Studies have proven that R&D procurement has been relatively honest (40:18). R&D is a business that does not attract thieves, rather it is a gratifying experience to the people that work in it (40:16).

One performance problem caused by the many policies and regulations that have been imposed in government R&D is that the system has fallen into one of response to requirements (41:13). These policies and regulations have created a very complex procurement process in which there is very little room for positive initiative (41:15).

Other causes of performance problems have their roots in the contractor selected to perform the R&D effort. The causes for performance problems in R&D vary from agency to agency. In this section, some very general causes for these problems will be discussed along with the opinions expressed by RADC personnel.

One very common cause for performance problems in R&D is the shrinkage of defense R&D funds. Since R&D has a long-term effect on our economy, the funds appropriated for these type of efforts are the first ones to be cut. This situation is probably due to the fact that R&D does not usually present a short-term solution to a problem.

By shrinking R&D funds, many of the technological avenues that are open for study are suddenly closed. This

creates a backlog on research that ultimately affects the satisfactory performance of R&D efforts.

Another problem of the shrinkage of defense funds is that it tends to stretch-out many R&D efforts. This stretch-out causes increases in program costs, affects the satisfactory performance of the effort, and usually creates overruns.

One way to remedy the situation caused by the shrinking and cutting of defense R&D funds would be to authorize or appropriate funds for an R&D effort for more than one year. As a beginning, a two-year appropriations defense budget would be a good initiative.

The inappropriate selection of contract type for an R&D effort has been pointed out as one of the most common causes of performance problems in R&D (10; 33; 50; 59). By wrongly selecting the contract type for R&D, the performance of the effort is directly affected (10; 33; 50; 59). Since the implementation of CICA, the government has pushed for contract competition and fixed price contracts.

The use of fixed price contracts place performance risk almost exclusively on the contractor. Due to this high risk, contractors are unwilling to deviate from the exact requirements in the SOW and much of the imagination and creativity of the contractor is hampered (41:15). But, the exclusive use of cost type contracts, as in the past, for R&D procurement would place all the risk on the government's side

and the incentives to control costs by the contractor would be lost (41:14).

In order to minimize performance problems caused by selecting the wrong type of contract, a very good evaluation of the effort and its requirements has to be conducted during the planning stage of the effort.

The Appropriations Act has made the use of fixed price contracts for high cost R&D efforts more difficult. Now, the use of fixed price contracts for R&D efforts valued over $10 million has to be approved by higher headquarters.

The lack of teamwork by contracting officers, program managers, and contract administrators is another common cause of performance problems encountered in R&D (36; 45; 50; 62). This lack of communication often contributes to the lack of understanding in the effort and finally, the product resulting from such effort is not as efficient and effective as it could be. Problems in this area could be resolved by teamwork between these individuals. This teamwork should start early in the acquisition process.

The lack of reasonable definite plans or poor SOW's when procuring an R&D effort could be visualized as another cause of performance problems (45; 57; 67). The lack of these plans sometimes causes the cancellation of programs or efforts once they have started, i.e. Strategic Defense Initiative efforts. These efforts do not appear to have been well defined and most of these efforts have been cancelled. One way to remedy this situation is to study the government

requirements early in the planning stages and then go on to procure the efforts or studies that are of any real interest to national defense.

Lack of trust between the government and contractor usually causes problems in performance (36). The constant oversight of the government sometimes impairs the ability of the contractor to study new possibilities and strategies to attack this type of effort. This is sometimes caused by the conservative methodology used by the government (36). A way to remedy this problem would be to place more trust in the contractor and allow the contractor some liberty in searching for new or improved technology.

Unrealistic delivery schedules could be viewed as a performance problem. The use of an unrealistic delivery schedule causes poor performance and does not contribute to an effective and efficient product (56; 57). This situation could be controlled by preparing a realistic acquisition plan and not by trying to accommodate it to the existing budget available at the time.

In small R&D efforts one common cause of performance problems is poor management by contractor personnel (65). It appears, that usually this poor performance is a product of big companies competing for small R&D efforts. This situation is caused sometimes by big companies that do not use their best personnel for these efforts because of the relatively small dollar value of these efforts (66). Some of these companies tend to use new, inexperienced personnel for

these efforts. One way to remedy this situation is to make the contractor comply with all the requirements in the SOW and make sure that capable personnel are used to perform these efforts (66).

Finally, another cause of performance problems in R&D has been the discovery of contractor misconduct when performing R&D effort. This situation is under study at this moment, and solutions are being developed (69:6-7).

All of the above circumstances could cause performance problems if not attended properly. The best solution to these problems is to remember that every R&D effort is a combination of teamwork and every effort is to be taken very seriously.

Some ways in which the procurement process for small R&D efforts could be improved were discussed by RADC personnel. Many of the opinions centered around using better acquisition planning for small R&D efforts (67). By making better use of acquisition planning, many performance problems could be minimized.

The training of engineers to become better contract managers would benefit the R&D process immensely (67). This training will help these individuals make better business decisions. Engineers are not usually trained to be managers (67).

If some of the rules, policies, and socioeconomic policies that have been imposed in R&D are reviewed, many of them could be eliminated (10; 33; 36; 42; 45; 50).

Eliminating the rules and policies that are not needed would take a very big burden from the CO's in the R&D procurement process (36; 38).

By making the government R&D process less formal and conservative, better products would be obtained (38). One way to achieve this is to give more flexibility to the officers that work the R&D process. This would allow these individuals to make more reasonable judgments (38; 62).

Another way to improve the R&D program would be to eliminate much of the duplication and unnecessary paperwork (56). This would allow the officers in the R&D process to have more time to spend working in other important areas of contracting.

A very simple way to improve the R&D process is to provide the contracting officers, program managers, and contract administrators the proper training to work in R&D efforts. R&D is a branch of contracting that is not equal to the others. It is a unique way of procurement and individuals are not properly trained in this complex area (59). It is necessary to train people to understand the requirements in R&D and the reasoning behind them. By conducting such training sessions, many of the problems in R&D would be resolved.

IV. Conclusions and Recommendations for Future Research

Conclusions

The comprehensive examination of literature in government R&D contracting, and the information gathered through informal interviews with contracting personnel from RADC, Griffiss AFB NY provide insights into the very complicated world of R&D procurement. R&D is the first step in the acquisition of systems for the security and protection of this nation. R&D procurement can be broken down in as many as six different stages.

The stages in government R&D procurement range from basic research performed to study the different ideas and alternatives that have potential for further study and are related to national security, to management and support of some of these activities. Research is the first stage of R&D and consists of basic studies in areas of interest to national security. Once this stage is completed, the next stage is exploratory development. Exploratory development is geared towards specific military problems, and together with research comp e what is known as the technology base.

Once the above two stages have been completed, the stages of advanced, engineering, and operational systems development follow. These stages are the major expenses in R&D. In these stages, prototypes, initial production, and tests are conducted in the systems under investigation. In some exceptional circumstances, management and support of the

R&D products follows these stages and completes the cycle of R&D procurement.

R&D and its interaction with the economy was found to be a critical part of this procurement. The necessity of good management and planning in R&D is of vital importance for the success of the procurement process. It was discovered that some of the problems encountered in R&D are closely related to the long-range payoffs of this procurement; the government's emphasis on short-range payoffs has affected R&D greatly.

The gambit of firms that offer R&D services is enormous, but it has been argued that the government's push for competition has caused a shrinkage in the amount of firms that are willing to venture into government R&D procurement. The importance of small businesses, educational institutions, and federally funded research and development centers in different stages of government R&D procurement was presented and confirmed.

The importance of R&D Statements of Work, Technical Evaluation Criteria, and Source Selection in government R&D procurement was discussed. These three elements form the strength of government R&D procurement and should be treated with a lot of caution and thought. Efficient and effective planning for these elements are the most important parts of the procurement process and are the determinants of success or failure of this process. Failure to properly manage and

plan for these elements will produce mediocre results at its best.

Competition and contract types in R&D procurement have been two factors under study for a long time. Since the implementation of CICA, the government's push for competition and fixed price contracts has been gigantic. The risks associated with different contract types in R&D procurement have been a factor of criticism since its conception. This study suggests that fixed price contracts are the most appropriate contract type for small dollar R&D studies. Cost reimbursement type contracts are the best type for large dollar R&D procurement. A hybrid combination of fixed price and cost reimbursement type contracts are the best alternative for medium dollar R&D procurement.

Another area of study in this research dealt with the very important roles of the Contracting Officer, Program Manager, and Contract Administrator in government R&D procurement. These individuals have to make sure that the effectiveness and efficiency of government R&D procurement is carried out as established in the contract document. These three officers have to work together in order to accomplish the success of government R&D procurement. The duty carried out by these officers is critical to the success of any government R&D contracting effort.

Most of the performance problems in R&D have reasonable and achievable solutions. Better training and support for R&D participants should be provided. Better pay and

incentives for scientists and engineers should be made available in order to be able to maintain a competent work force in the government's side of the procurement. The rules and regulations imposed in government R&D should be reviewed and updated. Much of the duplication effort that is performed in government R&D procurement should disappear.

R&D is a very complex area of study that deserves much attention. Technological superiority and the comforts enjoyed by the people in this nation are closely related to government R&D procurement. This area should never be allowed to lag behind and should be given proper attention.

Recommendation for Future Research

This research could not study all of the considerations associated with government R&D. Many of the researched topics were not discussed in a great detail. One area excluded was the R&D effort being conducted by private industry.

Another area of consideration would be to concentrate on two or three of the areas discussed in this research and conduct a very detailed examination of the same.

The constant changes in policy and regulations in R&D procurement make this topic one that should be updated every couple of years. How these changes affect this type of procurement should be considered for future research.

It appears that government R&D contracting will be always open to changes and study. R&D is considered to be an environment plagued by constant changes. In reality, the

possibility for research in government R&D contracting is boundless. There is always more to learn when dealing with this subject.

Appendix: <u>Agenda of Informal Questions to be discussed with Contracting Personnel at RADC</u>

1. Please comment on the contract types available for R&D? Do you think any particular one is best?

2. Please comment on the role of small businesses and educational institutions in R&D?

3. What do you feel are the impacts of Defense budget cuts in R&D? How do you feel these cuts affect R&D procurement?

4. Do you feel that R&D is still a good alternative for private industries?

5. What do you feel is R&D's role in society?

6. How do the latest rules and policies impact R&D?

7. How important are Statements of Work in R&D procurement?

8. What do you feel is the impact of ECP's in R&D?

9. How important is the Technical Evaluation Criteria in the R&D procurement process?

10. What do you feel is the CO's role in R&D procurement?

11. What do you feel is the PM's role in the R&D procurement?

12. What do you feel is the Contract Administrator role in R&D procurement?

13. How important is Source Selection in R&D?

14. How important is Acquisition Planning in R&D?

15. In your opinion, what is/are the most common cause(s) of performance problems in R&D?

16. How do feel about having the Government as a customer of R&D efforts?

17. How would you improve the R&D process?

18. Is there any topic or area on R&D that you would like to comment on?

Bibliography

1. Ames, Robert S. "U.S. Must Understand the Link Between R&D and the Economy," Aviation Week and Space Technology, 127: 149-150 (12 October 1987).

2. Bard, Jonathan F. and others. "An Iterative Approach to R&D Project Selection and Termination," IEEE Transactions on Engineering Management, 35: 139-146 (August 1988).

3. Barnes, Robert E. "Contract Administration in DOD: 'Out of Sight, out of Mind?,'" Defense Management Journal, 20: 33-38 (Fourth Quarter 1984).

4. Beck, Alan W. "The Program Manager and the Contracting Officer: Shared Responsibility in Systems Acquisition," Contract Management, 25: 26-27 (March 1985).

5. Black, Kent M. "IR&D An Essential Element of National Defense," National Defense, 72: 33-37 (April 1988).

6. Carpenter, Betsy. "Can American R&D Survive Another Space Station?," U.S. News and World Report, 105: 70-72 (7 November 1988).

7. Cassidy, Robert. "Nation's CEOs Say U.S. May Lose its R&D Lead," Research and Development, 30: 17-20 (September 1988).

8. Charles, Daniel. "Report Asks Upgrade of Military R&D Labs," Science, 239: 1484 (18 November 1988).

9. Cheney, Dick. Secretary of Defense United States. Defense Management Report to the President. Unpublished report. Department of Defense, Washington D.C., 12 June 1989.

10. D'Angelo, Larry, Chief RADC/PKR. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 20 March 1989.

11. Delaney, Lt. Col. Gary L. "An Introduction to Government Contracting," Working Paper, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, 1986.

12. Dennis, Bernard K. "Strengthening Small Business Participation in Department of Defense Extramural Research and Development," Defense Technical Information Center Report: 507-511 (March 1984) (AD-A137700).

13. Department of the Air Force. Formal Source Selection for Major Acquisitions. AFR 70-15. Washington: HQ USAF, 27 April 1988.

14. Department of the Air Force. Research and Development Contracting: Student Manual. GSA Training Center (HDA). Washington: Government Printing Office, 1983 edition.

15. Department of the Air Force. Streamlined Source Selection Procedures. AFR 70-30. Washington: HQ USAF, 27 April 1988.

16. "DOD Contracting Officer, The: A Study of the Past An Assessment of the Present, Recommendations for the Future," Program Manager, 17: 29-33 (March/April 1988).

17. Department of Defense. Defense Acquisition Program Procedures. DOD Directive 5000.2. Washington: Government Printing Office, 1 September 1987.

18. Department of Defense. Major and Non-Major Defense Acquisition Programs. DOD Directive 5000.1. Washington: Government Printing Office, 1 September 1987.

19. Department of Defense. Methods of Procurement: Contract Type Solicitations, Research and Development. Chicago: Commerce Clearing House, Inc., 1988.

20. Department of Defense. Research and Development Contracting. DOD FAR SUP PART 35. Chicago: Commerce Clearing House, Inc., 1988.

21. Department of Defense. Research and Development Contracting. FAR Part 35. Chicago: Commerce Clearing House, Inc., 1988.

22. Eisenstodt, Gale. "Now You See It," Forbes, 142: 218 (14 November 1988).

23. Farr, Maj. Charles M. Class handout distributed in CMGT 520, The Competition in Contracting Act (CICA) of 1984. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, April 1988.

24. Gannes, Stuart. "The Good News About U.S. R&D," Fortune, 117: 48-50+ (1 February 1988).

25. Goering, Col. Robert G., Director RADC/PK. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 20 March 1989.

26. Goodman, Glenn W. "Independent R&D Efforts Suffer in DoD's More Competitive Contract Environment," Armed Forces Journal International, 124: 102-104 (June 1987).

27. Goodwin, Irvin. "NSF Surveys Indicate Slower Pace For R&D, Even Military Work," Physics Today, 41: 74 (May 1988).

28. Graham, David. "The Pentagon and Basic Research," Technology Review, 91: 12-13 (May/June 1988).

29. Grier, Peter. "R&D Bonanza Nearing End," Military Forum, 5: 78-80 (July/August 1988).

30. Grosson, Joseph F. and Augusta, Joseph H. "Cost of Competition and its Consideration in the Acquisition Strategy," Program Manager, 15 : 33-36 (July/August 1986).

31. Heroux, Richard R. "There Has To Be A Better Way," Program Manager, 16: 9-13 (May/June 1987).

32. Howerton, Yvonne F. "Closing the Gap Between R&D and Application in Academe to Better Support Government and Industry," Defense Technical Information Center Report: 88-89 (AD-A137700).

33. Iannello, Greg, Contracting Officer RADC/PKC. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 23 March 1989.

34. Jones, Robert R. "Research and Development: New Sources, Still Essential," Research and Development, 30: 13 (September 1988).

35. Jones, Robert R. "R&D Industry Developing an Entirely New Look," Research and Development, 30: 78-81 (May 1988).

36. Kiszelewski, Matt, Contracting Officer RADC/PKRM. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 21 March 1989.

37. Kitfield, James. "New Rules, New Risks, New Worries," Military Logistics Forum, 4: 10-13 (July/August 1987).

38. Kloven, Arnold J., Contracting Officer RADC/PKRD. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 21 March 1989.

39. Loomis, Mortimer J. Technology and Marketing in the Award of Research and Development Contracts. MS Thesis. Massachusetts Institute of Technology, Massachusetts, June 1986.

40. Lubkin, Yale J. "Achieving Effectiveness in R&D, Part 1," Defense Science, 6: 14-16 (November 1987).

41. Lubkin, Yale J. "Achieving Effectiveness in R&D, Part 2," Defense Science, 6: 14-16 (December 1987).

42. Mancuso, Gary, Contract Specialist RADC/PKRD. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 21 March 1989.

43. Marback, William D. and Smith Emily T. "A Perilous Cutback in Research Spending," Business Week, No. 3056: 139-144 (20 June 1988).

44. Marshall, Eliot. "Research and the Flexible Freeze," Science, 242: 1368-1370 (9 December 1988).

45. McCaa, Craig, Lawyer RADC/JA. Personal Interview. Rome Air Development Center/Legal Office, Griffiss AFB NY, 24 March 1989.

46. McCarty, Dyke. Class handout distributed in CMGT 520, *The Acquisition of Major Systems.* School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, August 1987.

47. Morrocco, John D. "Cuts in Basic Research Funding Threaten Competitive Strategies," Aviation Week and Space Technology, 120: 19 (7 March 1988).

48. Nicholas, George T. "The Industrial Base Under Seige," Contract Management, 27: 4-13 (July 1987).

49. Office of Federal Procurement Policy; Office of Management and Budget. Small Firms and Federal Research and Development. AD Hoc Interagency Panel. DTIC (A1078829). 24 February 1977.

50. Paytash, Paul, Contracting Officer RADC/PKRL. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 20 March 1989.

51. Peterson, Blair A. "Military and Civilian R&D: A Comparison of Expenditures," Program Manager, 17: 8-14 (March/April 1988).

52. Porro, Jeffrey D. "The Pentagon and Basic Research," Technology Review, 91: 12-13 (May/June 1988).

53. Pursch, William C. Thesis Advisor. Personal Interview. Wright-Patterson AFB OH, 1 January 1989.

54. Raloff, J. "FY'89 budget: Lean and much less defense-oriented," Science News, 133: 134-138 (27 February 1988).

55. Randolph, Bernard P. "Air Force R&D: Challenge of 1990s, "National Defense, 72: 52-55 (July/August 1988).

56. Reed, Linda, Contracting Officer RADC/PKRZ. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 22 March 1989.

57. Reed, Capt Steve R., Contracting Officer RADC/PKRD. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 22 March 1989.

58. Roman, Daniel D. Research and Development Management. New York: Appleton Century Crofts Press, 1968.

59. Ross, Ned, Contracting Officer RADC/PKRZ. Personal Interview. Rome Air Development Center/Contracting Directorate Griffiss AFB NY, 23 March 1989.

60. Sherman, Stanley N. Government Procurement Management. Gaithersburg, Md.: Wordcrafters Publications, 1985.

61. Sheth, Jagdish N. and others. "Government and Business Purchasing: How Similar Are They?," Journal of Purchasing and Materials Management, 19: 7-13 (Winter 1983).

62. Smith, Richard, Chief RADC/BC. Personal Interview. Rome Air Development Center/Small Business Office, Griffiss AFB NY, 23 March 1989.

63. Thybony, William W. Class handout distributed in CMGT 520, Excerpt on Acquisition Planning. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, 1987.

64. Thybony, William W. Class handout distributed in CMGT 520, Excerpt in Descriptions of Government Requirements. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, 1987.

65. Vepsalainen, Ari P. J. and Lauro, George L. "Analysis of R&D Portfolio Strategies for Contract Competition," IEEE Transactions on Engineering Management, 35: 181-186 (August 1988).

66. Wallaesa, Carla, Chief RADC/PKRD. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 21 March 1989.

67. Welsh, Glenn, Contracting Officer RADC/PKRL. Personal Interview. Rome Air Development Center/Contracting Directorate, Griffiss AFB NY, 23 March 1989.

68. White, Eileen. "Defense Contractors Slim Down to Survive Lean Times," The Wall Street Journal, 112: 6+ (30 September 1987).

69. Zurer, Pamela. "Scientific Fraud: Tighter Rules on Research on the Way," Chemical Engineering News, 66: 6-7 (26 September 1988).

Vita

Captain Oscar V. Rodriguez-Morales [redacted] He attended college at the University of Puerto Rico, Mayaguez Campus, from which he received a Bachelor of Science in Chemical Engineering in May 1985. Upon graduation, he was commissioned in the USAF through the ROTC program in June of 1985. In his first assignment, he served as an R&D Acquisition Contracting Officer at Rome Air Development Center, Griffiss AFB New York from July 1985 to May 1988. While at Griffiss AFB he completed 18 semester hours of the 36 hour Master of Science in Business Management with the State University of New York, Binghamton Campus. He remained at Griffiss until entering the School of Systems and Logistics, Air Force Institute of Technology in May of 1988.

[redacted]

Permanent Address: [redacted]

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b. RESTRICTIVE MARKINGS

2a. SECURITY CLASSIFICATION AUTHORITY

2b. DECLASSIFICATION / DOWNGRADING SCHEDULE

3. DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release; distribution unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
AFIT/GCM/LSP/89S-9

5. MONITORING ORGANIZATION REPORT NUMBER(S)

6a. NAME OF PERFORMING ORGANIZATION
School of Systems and Logistics

6b. OFFICE SYMBOL (If applicable)
AFIT/LSM

7a. NAME OF MONITORING ORGANIZATION

6c. ADDRESS (City, State, and ZIP Code)

7b. ADDRESS (City, State, and ZIP Code)

8a. NAME OF FUNDING / SPONSORING ORGANIZATION

8b. OFFICE SYMBOL (If applicable)

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c. ADDRESS (City, State, and ZIP Code)

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
GUIDE TO SPECIAL CONSIDERATIONS IN GOVERNMENT RESEARCH AND DEVELOPMENT CONTRACTING

12. PERSONAL AUTHOR(S)
Oscar V. Rodriguez-Morales, Captain, USAF

13a. TYPE OF REPORT
MS THESIS

13b. TIME COVERED
FROM ________ TO ______

14. DATE OF REPORT (Year, Month, Day)
1989 September

15. PAGE COUNT
107

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP
15	05	
05	01	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Acquisition; Government Procurement; Research and Development; Contracts

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Thesis Chairman: Dr. William C. Pursch
Department Head
Department of Contract Management

Approved for public release: IAW AFR 190-1.
Larry W. Emmelhainz
LARRY W. EMMELHAINZ, Lt Col, USAF 11 Oct 89
Director of Research and Consultation
Air Force Institute of Technology (AU)
Wright-Patterson AFB OH 45433-6583

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL
William C. Pursch

22b. TELEPHONE (Include Area Code)
513 255-3394

22c. OFFICE SYMBOL
LSP

This study researched applicable literature on special characteristics related to Government R&D Contracting. Emphasis was placed on small dollar government R&D procurement. A comprehensive literature review, together with informal interviews with contracting personnel from RADC Griffiss AFB NY were used to develop this study. The special characteristics include R&D definitions, different stages in R&D, R&D's interaction with the economy, technical considerations in R&D, R&D contract types, competition and R&D, roles of critical officers in R&D contracting, and some performance problems encountered in R&D. The research for this study showed that R&D is a fundamental component of this nation's technological leadership. Better training is required for personnel involved in R&D procurement. Contracting Officers, Program Managers, and Contract Administrators are part of a very important team which is in charge of supervising the efficiency and effectiveness of government R&D procurement. Most of the performance problems encountered in government R&D procurement can and should be resolved for its success. This study will become part of NCMA's Body of Knowledge library and it condenses the special considerations in government R&D contracting in a manner that is easily accesible to interested readers with some experience in government contracting.